

Railway Mechanical Engineer

Name Registered U. S. Patent Office

Founded in 1832 as the American Rail-Road Journal

With which are also incorporated the National Car Builder, American Engineer and Railroad Journal, and Railway Master Mechanic.

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Editorial Contents for March, 1930

Volume 104

No. 3

Point St. Charles Shops of the Canadian National Page 117

A description of a new locomotive back shop which was placed in operation in July of last year. This shop handles a large part of the class repairs for the Central Region.

Screenings Successfully Burned in C. & E. I. Road Test Page 131

This article gives the results of a series of tests run on the Chicago & Eastern Illinois with a 2-10-2 type locomotive equipped with a mechanical stoker and Hulson Tuyere type grates.

Draft Gears for Passenger Cars Page 125

An abstract of a paper by C. T. Ripley, chief mechanical engineer, Atchison, Topeka & Santa Fe, which was presented before the January meeting of the Pueblo, Colo., Car Men's Association.

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Published on the first Thursday of every month by the Simmons-Boardman Publishing Company, 34 North Crystal Street, East Stroudsburg, Pa., and 30 Church Street, New York

SIMMONS-BOARDMAN PUBLISHING COMPANY, 30 CHURCH STREET, NEW YORK

Publishers also of Railway Age, Railway Engineering and Maintenance, Railway Electrical Engineer, Railway Signaling, Airway Age, Marine Engineering and Shipping Age, The Boilermaker, Locomotive Cyclopedia, Car Builder's Cyclopedia, and Railway Engineering and Maintenance Cyclopedia

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The Railway Mechanical Engineer is a member of the Associated Business Papers (A. B. P.) and the Audit Bureau of Circulations (A. B. C.)



Use Of Timken Bearings On Pennsylvania Railroad

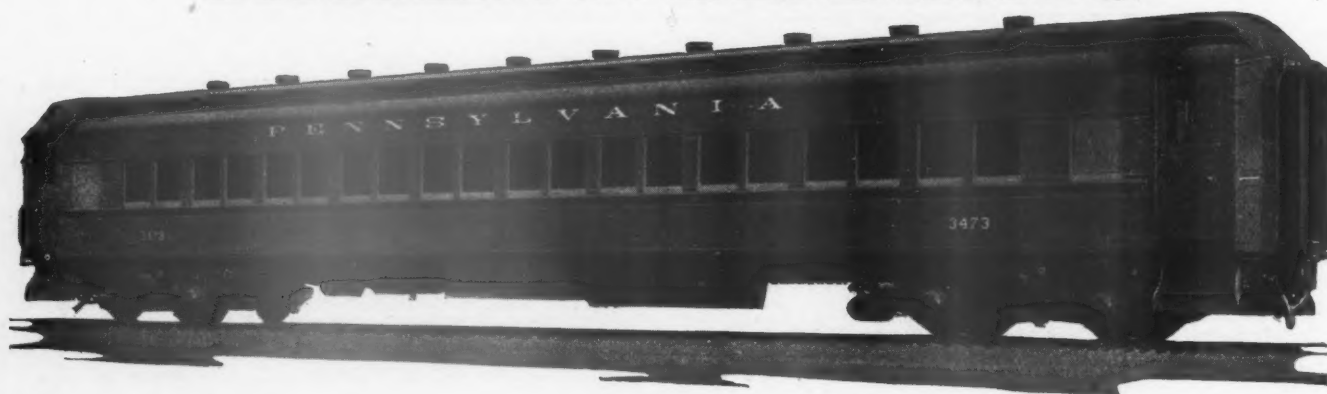
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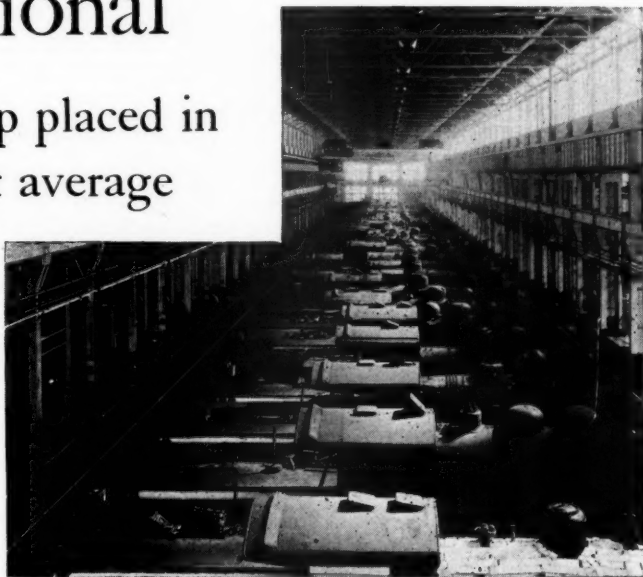
Point St. Charles Shops of the Canadian National

Modern locomotive repair shop placed in
operation last July turns out average
of 36 class repairs
per month

AT the time of the opening of the Grand Trunk in 1853, the repair shops were located at Longueuil, Que., on the south bank of the St. Lawrence River, 10 miles northeast of Montreal, Que. The increase in size and in the number of locomotives eventually taxed the capacity of these shops, so in 1857 the shops were moved across the river to Point St. Charles, which is located about three miles east of Montreal. New buildings were added to the original shops at Point St. Charles, as the demands on the repair facilities increased. However, as the Canadian National, of which the Grand Trunk now forms a part, procured new power of modern design it became necessary to build a maintenance plant which could handle the repairs to modern locomotives more economically than in the past.

Accordingly, plans and specifications for a new locomotive repair shop were prepared and approved. This shop was completed in July, 1929, and placed in operation at that time. This is the third unit to be completed under a rehabilitation and modernization program approved some years ago whereby all the old repair plants located at this point, comprising locomotive and car shops, grey iron foundry, stores, etc., will be replaced by completely modern facilities. The stores building was the first unit to be completed and has been in use about three years. The new power plant, which replaced two old power houses, was the second unit completed and was placed in service late in 1928. On July 16, 1929, the third unit, comprising the locomotive shop was placed in complete operation.

The entire project is being carried out within the limits of the original site. To accomplish this without



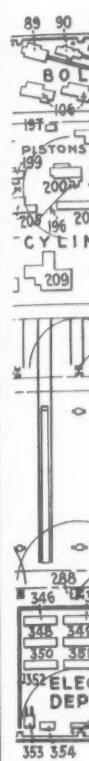
Erecting shop looking toward the boiler shop

undue curtailment of production, considerable study and planning, was required with the result that the final change over from the old to the new locomotive shop was completed in a period of two weeks. A considerable number of new and heavy machine tools and other equipment was installed along with such machinery as was modern enough to be transferred from the old shop.

All the plans and details were designed by, and erected under, the supervision of the Canadian National engineering staff, under the direction of S. J. Hungerford, vice-president in charge of operation, assisted by C. E. Brooks, chief of motive power, J. Roberts, general supervisor of shop methods, C. B. Brown, chief engineer, and W. A. Duff, engineer of standards.

Limitations imposed by the building site and the necessity of maintaining the old shop in operation during the construction of the new, practically dictated the designing of the new shop complete in a single building. In this respect, and considering its size and capacity, it is somewhat unique and distinctively different from other locomotive shops on this continent.

As will be seen from the plan, the building is rectangu-

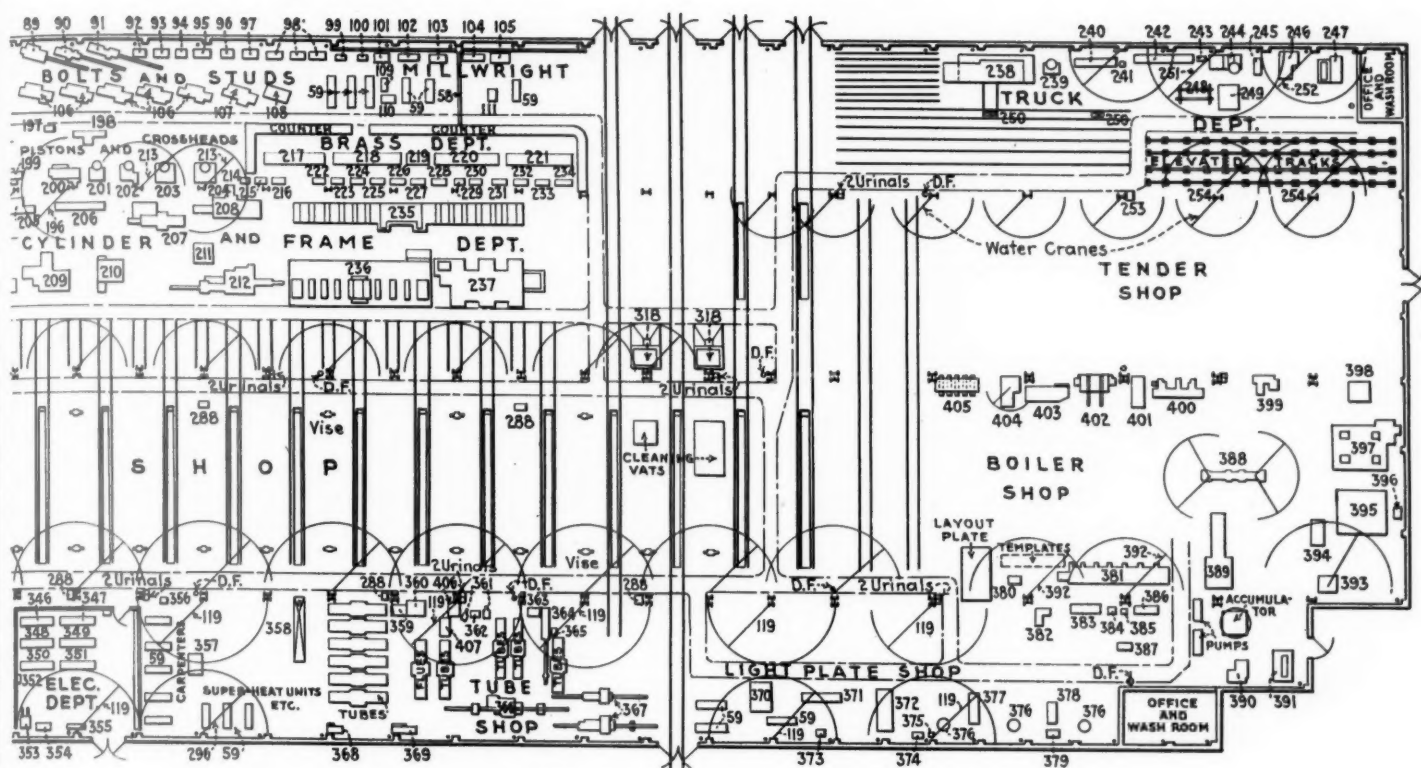


Canada

Drawing reference	Size or Capacity	Machine
264		Heavy bulldozer
265		Bolt threading machine
268	48 in. by 25 in. by 20 in.	Oil furnace
269	3 in.	Forging machine
270	1 in.	Bar shears
272	42 in. by 22 in. by 48 in.	Oil furnace
274	48 in. by 25 in. by 13 in.	Oil furnace
275 and 277	1 in.	Bolt forging machines
276 and 278	42 in. by 22 in. by 13 in.	Oil furnaces
289	675 cu. ft. per min.	Blower, 24 oz. pressure

	Welders	
59	Benches
112	Annealing furnace
118	Oxygraph shape-cutting machine
266	Electric welding generator
267	2,000 lb., 16-ft. radius ...	Column jib crane

Main and Side Rod Department		
55 and 56	.....	Double spindle rod borers
57	44 in.	Drill press
58	2,000 lb., 25-ft. reach ...	Wall bracket cranes
59	.....	Work benches
113	120 ton	Hydraulic bushing press
114	24 in.	Vertical turret lathe
115	36 in.	Vertical turret lathe
116	12 in.	Slotting machine
408	1,000 lb., 24-ft. radius ..	Column jib crane
121	3½ in. by 24 in.	Floor grinder
122	17 in. by 2 ft.	Bolt lathe
123	21 in. by 5 ft.	Lathe
124	21 in. by 44 in.	Lathe
128	12 in.	Crank shaper
129	15 in.	Crank shaper
132	No. 2	Churchill internal grinder
General Work Department		
117	36 in. by 12 ft.	Rod boring machine
119	2,000 lb., 24-ft. radius	Column jib crane
120	36 in. by 16 ft.	Slab milling machine
123	30 in.	Vertical milling machine
126	50 in. by 14 in. by 21 in.	Cincinnati plain milling machine
127	36 in. by 84 in.	Horizontal boring machine
153	9 in. by 20 in.	Plain milling machine
154	12 in. by 15 in. by 42 in.	Universal milling machine
155	16 in.	Drill slotting machine
156	24 in.	Vertical mill machine
157	7 ft. by 16 ft.	Face plate lathe
158	20 in. by 20 ft.	Engine lathe
159	40 in. by 7 ft.	Engine lathe
176	32 in.	Cold sawing machine
177	26 in. by 14 ft.	Traverse head shaper
178	42 in. by 42 in. by 10 ft.	Planer
179	32 in.	Heavy crank shaper
Motion Work Department		
59	.....	Motion parts rack and benches



Canadian National Point St. Charles Shops

Drawing reference	Size or Capacity	Machine	Drawing reference	Size or Capacity	Machine
60	120 ton	Bench	175	1,000 lb. 20 ft. radius	Column jib crane
61		Hydraulic bush press			
62		Screw hard press			
63		Set-up table, Young and Baker gears			
64		Motion test table	281		
131		Buffing and polishing machine	282		
133	24 in. by 66 in.	Lathe	283	24 in. by 22 in. by 24 in.	Electric furnace
134	21 in. by 54 in.	Lathe	284	60 ton	Spring banding machine
135	28 in. by 54 in.	Lathe	285	100 ton	Spring banding machine
136	3/4 in.	Twin spindle drill	287		Electric buckle furnace
137	3 ft.	Plain radial drill	289	35 ton	Spring testing machine
138		Drill press	290	100 ton	Spring stripping machine
139		Reach rod rack	291	1,000 lb., 20-ft. radius	Column jib crane
140		Churchill link grinder	292		Electric spring plate furnace
141		Horizontal boring mill	293	3/4 in. by 7 in. by 72 in.	Spring cambering machine
142	10 in. by 24 in.	Landis grinder	294		Electric spring plate furnace
143	No. 4	Universal grinder	295	3/4 in. by 7 in. by 84 in.	Spring cambering machine
144		Universal grinder	296	1,000 lb., 24-ft. radius	Column jib crane
145, 146 and 148	20 in. by 4 ft.	Lathes	297		Hot punch and nibbling machine
147	20 in. by 3 ft. 6 in.	Lathe	298		Oil furnace
149	20 in. by 3 ft.	Lathe	299		Spring plate tapering rolls
150	60 in. by 5 ft. 6 in.	Lathe	300		Spring plate rack
151	12 in. by 4 ft.	Pin grinder	301		Electric drawing furnace
152	60 in. by 5 ft. 6 in.	Gap lathe	302		Oil treating and cleaning baths
			303		Electric tempering furnace
			304	1/2 in. by 5 1/2 in.	Elliptic spring eye-forming machine
119	2,000 lb., 24-ft. radius	Column jib cranes			
160	500 ton	Wheel press			
161		Electric tire furnace			
162	100 in.	Tire boring mill			
169	100 in.	Boring mill	59		Work benches
170	96 in.	Boring mill	288	24 in. by 3 1/2 in.	Floor grinder
171	60 in. by 16 in. by 5 ft.	Gap lathe	296	1,000 lb., 24-ft. radius	Column jib crane
172	30 in. by 8 ft. 6 in.	Engine lathe	305	42 in.	Drill press
173	30 in. by 8 ft.	Engine lathe	306	120 ton	Hydraulic press
174	36 in. by 10 ft.	Heavy duty engine lathe	307	3 in. 4-spindle	Drill
175	1,000 lb. 20-ft. radius	Column jib cranes	308	1,000 lb., 20-ft. radius	Column jib crane
180		Locomotive axle journal turning and grinding machine	309 and 311	26 in. by 8 ft.	Engine lathes
181	90 in.	Combination pin turning and quartering machine	310	19 in. by 4 ft.	Engine lathe
182	90 in.	Heavy wheel lathe			
406		Wheel revolving machine	59		
			119		
			312	2,000 lb., 24 ft.	Work benches
			313	40 in.	Column jib crane
			314	18 in. by 4 ft.	Drill press
			315	20 in. by 4 ft.	Engine lathe
			316	21 in. by 3 ft.	Engine lathe
					Turbo generator repair bench and test
					Small cleaning vat
					Pump and jacket cleaning vat
					Distributing brake, signal and feed valve test
					Pump repair tables
					Pump rack
					Vise stands
					Hydraulic press
58	2,000 lb., 25-ft. reach	Wall bracket crane			
66	18 in. by 10 ft.	Traverse head shaper			
67		Sensitive drill			
68	36 in.	Drill press			
69	100 ton	Horizontal box press			
70	1,000 lb. 24-ft. radius	Column jib crane	317		
163	48 in. by 48 in. by 17 ft.	Planing machine	318		
164	36 in.	Heavy drawcut shaper	319		
165	3 ft.	Plain radial drill			
166	48 in.	Boring mill	320		
167	25 in. by 3 ft.	Engine lathe	321		
168		Bullard driving box boring machine	322		
			323	33 ton	Hydraulic press

Drawing reference	Size or Capacity	Machine	Drawing reference	Size or Capacity	Machine
Jacket and Tinsmith Department			Brass Finishing Department		
59	.....	Benches	214	.....	Auto. valve grinding machine
288	24 in. by 3 1/2 in.	Floor grinder	215	.....	Cock grinder
296	1,000 lb., 24-ft. radius ..	Column jib crane	216	.....	Milling machine
324	300 lb.	Drop hammer	217, 218, 220	.....	Double work benches
325	No. 18 gage	Punch press	and 221	.....	Buffing and polishing machine
326	1/2 in. by 6 in. by 9 ft.	Plate rolls	219	.....	.....
327	No. 18 gage by 8 ft.	Power squaring shears	222, 223, 224,	.....	.....
328	No. 10 gage by 8 ft.	Hand brake	225, 226, 227,	.....	.....
329	.....	Punch	228, 230, 231,	.....	.....
330	.....	Spot welder	and 234	16 in. by 24 in.	Brass lathes
331	No. 14 gage	Punch press	229	16 in. by 36 in.	Brass lathe
332	30 in.	Circle cutter	233	16 in. by 30 in.	Brass lathe
333	.....	Sensitive drill	234	16 in. by 18 in.	Brass lathe
334	1/2 in.	Sensitive drill	Electrical Department		
335	10 in. by 3 ft.	Lathe	119	2,000 lb., 24-ft. radius ..	Column jib crane
336	No. 18 gage 3 ft.	Squaring shears	335	.....	Test panel
337	No. 18 gage 2 ft. by 3 ft.	Tin rolls	346	.....	Shop maintenance bench
338	No. 24 gage	Edging and circle cutter	347	.....	Engine repair bench
339	No. 24 gage 30 in.	Shears	348	.....	Headlight armature repair bench
Tool Room			349	.....	Turbo generator rack
71	20 in. by 72 in.	Tool lathe	350	.....	Headlight turbine repair bench
72	20 in. by 48 in.	Tool lathe	351	.....	Coil spreading and general winding
73	16 in. by 36 in.	Tool lathe	352	.....	Turbo test rack
74	9 in. by 15 in. by 33 in.	Horizontal milling machine	353	.....	Armature and coil baking oven
75	.....	Sensitive drill	354	.....	Coil winding lathe
76	.....	Tool grinder	Carpenters		
77	.....	Universal tool grinder	59	.....	Benches
78	.....	Electric tempering furnaces	119	2,000 lb., 24-ft. radius ..	Column jib crane
79, 80 and 82	16 in. by 36 in.	Lathe	356	.....	Wet grindstone
81	20 in. by 60 in.	Lathe	357	.....	Universal woodworking machine
83	No. 1 1/2	Universal tool grinder	Superheater Units, Throttles, Etc.		
84	.....	High speed steel cutting-off machine	59	.....	Benches
85	14 in. by 1 1/2 in. by 1 1/2 in.	Floor grinder	296	1,000 lb., 24-ft. radius ..	Column jib crane
86	.....	Power hack saw	358	.....	Unit testing machine
Tool and Petty Store			Tube and Flue Department		
59	.....	Bench	119	2,000 lb., 24-ft. radius ..	Column jib crane
183	.....	Tool and material shelves	359, 362 and 363	.....	Electric tube furnaces
184	.....	Sellers tool grinder	360	6 in.	Rotary tube welding machine
185	No. 2	Universal cutter and tool grinder	361	.....	Pneumatic tube welding hammer
186	14 in. by 1 1/2 in. by 1 1/2 in.	Wheel grinder	364	.....	Hot saw
Frame and Cylinder Department			365	.....	Tube expander
195	60 in. by 60 in. by 18 ft.	Planer	366	6 in.	Tube scaling machine
207	48 by 10 ft.	Horizontal boring machine	367	2 in.	Tube scaling machine
208 and 212	.....	Cylinder boring machines	368 and 369	.....	Safe end cutting-off machines
209	6 ft.	Universal radial drill	406	.....	Vertical abrasive machine
211	.....	Cylinder fitting pit	407	5 in.	Electric tube welding machine
216	60 in.	Morton drawcut shaper	Ash Pans and Light Plate Work		
235	96 in. by 84 in. by 45 ft.	Frame planer	59	.....	Benches
236	34 in. by 63 in. by 50 ft.	Frame slotting machine	119	2,000 lb., 24-ft. radius ..	Column jib crane
237	6 ft., 3-head	Universal radial drill	370	.....	Laying out table
Piston and Crossheads			371	5/8 in.	Punching and shearing machine
168	1,000 lb., 20 ft.	Radius column jib crane	372	3/4 in. by 12 in. by 8 ft.	Plate rolls
187	42 in. by 42 in. by 10 ft.	Planer	373	24 in. by 3 1/2 in.	Floor grinder
188	12 in.	Slotting machine	374	1,000 cu. ft. per min.	Pressure blower, 16 oz. pressure
189	18 in. by 4 ft.	Engine lathe	375	4,500 cu. ft. per min.	Exhaust fan, 1 1/4 in. static pressure
190	20 in. by 4 ft.	Engine lathe	376	.....	Forge fires
191	.....	Keyway milling machine	377	.....	Hydraulic plate clamp
192	20 in.	Drill press	378	1,000 lb.	Bradley helve hammer
193	.....	Guide bar grinder	379	.....	Hydraulic press
194	.....	Crosshead press	382	5-ft. radius	Universal radial drill
196	1,000 lb., 18-ft. radius ..	Column jib crane	380	100 ton	Hydraulic close corner punch
197	24 in. by 3 1/2 in.	Grinder	Boiler Shop		
198	14 in. by 22 in.	Vertical milling machine	381	1 in. by 32 ft.	Plate planing machine
199	32 in. by 5 ft.	Engine lathe	383a	.....	Sensitive drill
200	34 in. by 6 ft.	Engine lathe	383	6 spindle	Staybolt threading machine
201	36 in.	Bullard vertical turret lathe	384	.....	Telltale hole drill
202	42 in.	Bullard vertical turret lathe	386	14 in. by 5 ft.	Staybolt lathe
203	54 in.	Bullard vertical turret lathe	387	3 in. by 3 in.	Angle bar shears
205	24 by 120 in.	Rod grinder	388	1 in. by 5 ft.	Throat punch and shear
206	32 in. by 16 ft.	Engine lathe	389	1 in. by 20 in. by 14 ft.	Horizontal plate bending rolls
213	54 in.	Cylinder bushing mill	390	37 ton	Gap riveting machine
Bolt and Stud Department			391	125 ton 12 ft.	Gap riveting machine
89	2 in. by 10 in. by 36 in.	Turret lathe	392	2,000 lb. 20-ft. radius ..	Column jib crane
90	2 in. by 24 in. by 24 in.	Turret lathe	393	4,000 lb. 25-ft. radius ..	Pillar crane
91	2 in. by 24 in. by 30 in.	Turret lathe	394	37 ton	Sectional flange press
92	8 in. by 30 in.	Turret lathe	395	.....	Plate flanging furnace
93 and 94	2 in.	Turret lathes	396	2,200 cu. ft. per min.	Pressure blower, 24 oz. pressure
95	2 in.	Nut facing machine	397	575 ton	Hydraulic flange press
96	17 in. by 24 in.	Bolt lathe	398	.....	Straightening block
97	.....	Bolt centering machine	399	1 in.	Rotary bevel shears
98	14 in. by 6 ft.	Bolt lathes	400	3 in.	Foundation ring and flue sheet drill
106	3 1/4 in. by 36 in.	Turret lathes	401	6 ft.	Radial drill
107	6 in. by 24 in.	Turret lathes	402	2-spindle	Tube sheet drill
108	3 1/2 in. by 36 in.	Turret lathes	403	1/2 in. by 12 in. by 8 ft.	Straightening rolls
Millwright Department			404	4 ft.	Radial drill
58	2,000 lb., 25-ft. reach	Wall bracket crane	405	.....	Rack for smokebox fronts
59	.....	Benches	Truck Department		
99	12 in.	Power hack saw	238	52 in.	Heavy car wheel lathe
100	.....	Sensitive drill			
101	36 in.	Drill press			
102	16 in. by 5 ft.	Lathe			
103, 104 and 105	18 in. by 4 ft.	Lathes			
109	33 ton	Hydraulic press			
110	.....	Layout table			
111	100 ton	Jack testing machine			

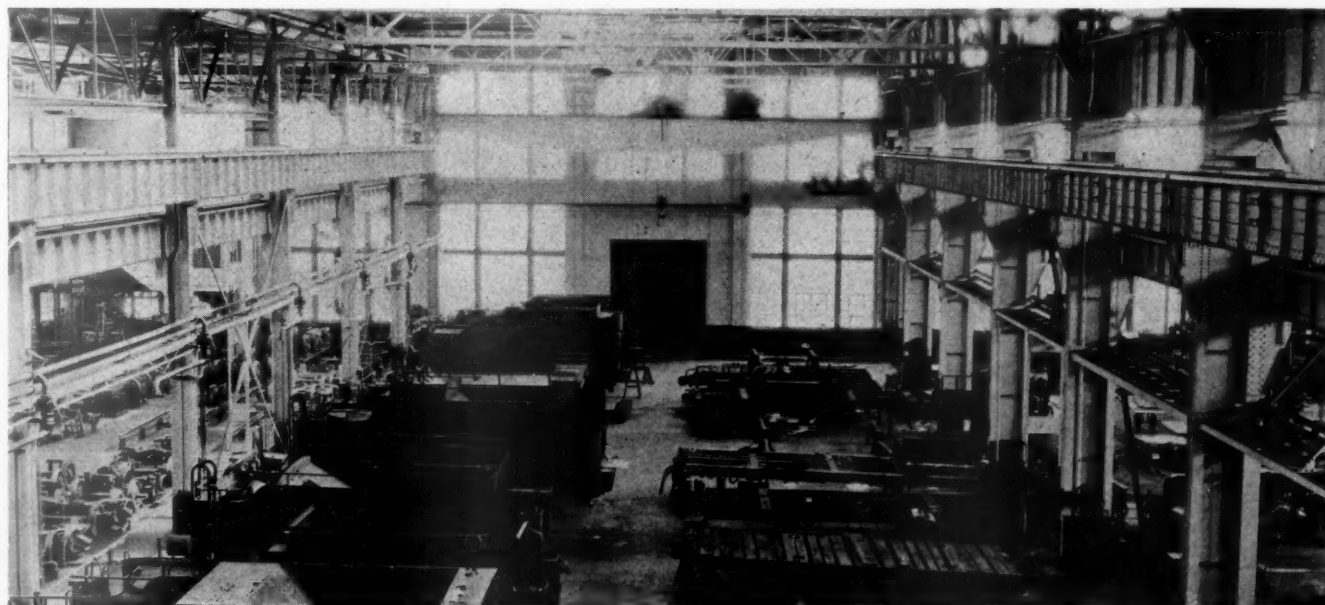


Photograph taken in the heavy machine bay at night

Drawing reference

239	60 in.	Boring mill
240	400 ton	Hydraulic wheel press
241	2,000 lb., 20-ft. radius ...	Column jib crane
242	52 in. by 10 ft.	Journal turning lathe
243	17 in. by 2 ft.	Bolt lathe
244	48 in.	Tire boring mill
245	24 in.	Shaping machine
246	6 ft.	Radial drill
247	5 ft.	Radial drill
248	.....	Tire setting trestles
249	.....	Electric tire heating furnace
250	.....	Pneumatic wheel jacks
251	2,000 lb., 26-ft. radius ...	Column jib crane
254	2,000 lb., 21-ft. radius ...	Column jib crane
Pipe Shop		
59	.....	Benches
340	18 in.	Power hack saw
341	2 in.	Pipe threading machine
342	4 in.	Pipe threading machine
343	6 in.	Pipe threading machine
344	.....	Hydraulic pipe bending machine
345	.....	Forge fires

transverse bay across the west end, which is assigned to the forge shop.



The tender shop—The 40-ton crane is shown in the background—Water jacks are shown on each column at the left for filling tender tanks and testing

Starting at the south side of the building, the first bay, 55 ft. 10 in. center to center of the columns, is designated as the miscellaneous bay. It contains the following sub-departments: The spring shop, brake and spring gear department, tube and flue shop, air-brake and feedwater-equipment repair shop, electrical repair shop, jacket and tin shop, pipe shop, woodworking shop and the light plate shop. This bay also contains the riveting tower.

The second bay is 85 ft. wide and contains a 31-pit erecting shop. A space 216 ft. long at the east end comprises the main boiler shop. The third bay, 70 ft. wide, is the heavy machinery bay, with the exception of 264 ft. at the east end, which contains the tender tank and frame shop. The fourth bay, 54 ft. 6 in. wide is devoted principally to the light machinery, with the exception of 264 ft. at the east end, which is assigned to tender and engine-truck repairs.

The entire superstructure stands on concrete piles, as the building site is only a few feet above the normal level of the St. Lawrence River. On the outside walls, the concrete is carried up 5 ft. above the floor level to the first row of windows, and from that point up, the walls are of red brick with reinforced concrete bands above each row of steel window sash. All roof drainage is carried down inside the building to storm sewers.

Natural Lighting

The distribution of natural light has been well taken care of and uniform diffusion is assisted by coating the entire interior of the solid walls, and roof, together with all steel superstructure and office structures, with aluminum paint down to within 5 ft. of the floor level. The remaining 5 ft. is finished in black. The erecting bay, which is higher than the remainder of the shop, is provided with clerestory windows only. All remaining bays have skylights. Distribution of glass is as follows:

Area of side wall glass	45,000 sq. ft.
Area of clerestory glass	22,200 sq. ft.
Area of skylight glass	51,810 sq. ft.
Percentage of side wall glass to side wall area.....	39.5
Percentage of total glass area to floor area.....	43.0

Artificial Lighting

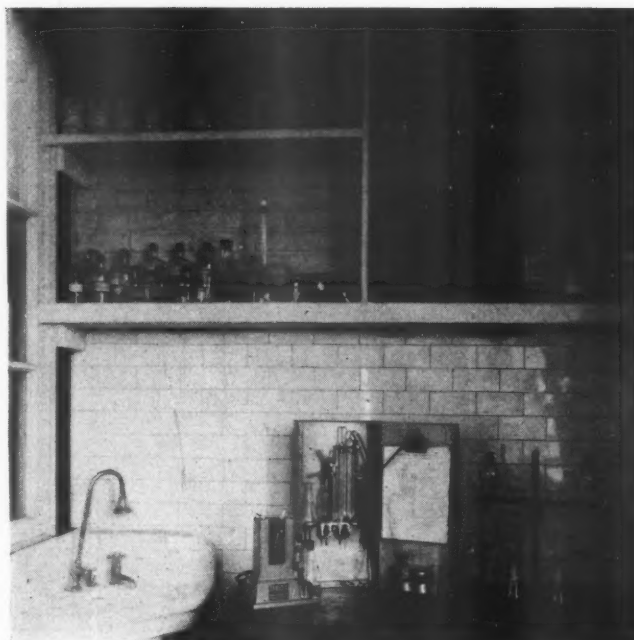
Overhead lighting is used throughout the shop. Holograph reflectors are suspended on flexible brackets from

the roof trusses, allowing the reflectors to hang level with the lower chord of the truss. Each fixture is hung on a hook on the end of the bracket and is coupled to a wiring circuit by a plug connection, to facilitate removal for repairs. All fixtures are easily reached from the top of the electric cranes for cleaning, bulb renewal, or repairs. Lamps are controlled in groups of six from control cabinets conveniently located on building columns. In the erecting bay, on account of the height, two 750-watt bulbs are used per building panel of 24 ft. At the boiler shop end of this bay, three 750-watt bulbs are required as the building panels in this section are 36 ft. wide. The remainder of the shop is equipped with 500-watt bulbs, the heavy machine bay and forge shop having three per building panel, while the balance of the shop has two.

In addition, all the heavy machine tools and a large proportion of the smaller machines are wired either for bracket lighting fixtures or extension cords as may be required. Each locomotive pit has five Oliver plug receptacles, three at the back end and two at the front end, controlled from lighting cabinets on building columns. For night lighting purposes, a few of the regular service lamps are connected up by a third wire system and may be controlled either directly from the power house or from cabinets in the main shop. A light is also provided outside over each doorway, a pair of flood lights being placed over the doorways at the outgoing and incoming tracks.

Electric-Welding Circuits

The boiler and tank shops are wired for electric-welding equipment through a sub-floor conduit to plug stations located at convenient points on building columns. Current for this circuit is supplied by a Wilson generator set which is permanently located at the center of distribution. Also, at the west end of the erecting and machine bays, another welding machine is located which supplies current to four stationary panels in a small welding department handling miscellaneous parts. In the erecting bay all even-numbered building columns at the rear of the locomotive pits are wired for, and connected to, Oliver 3-pole, 600-volt safety switches for operating



Section of the chief engineer's office showing the apparatus used for analyzing boiler feed water

portable electric welders and electric rivet heaters, there being 15 stations installed.

Overhead Travelling Cranes

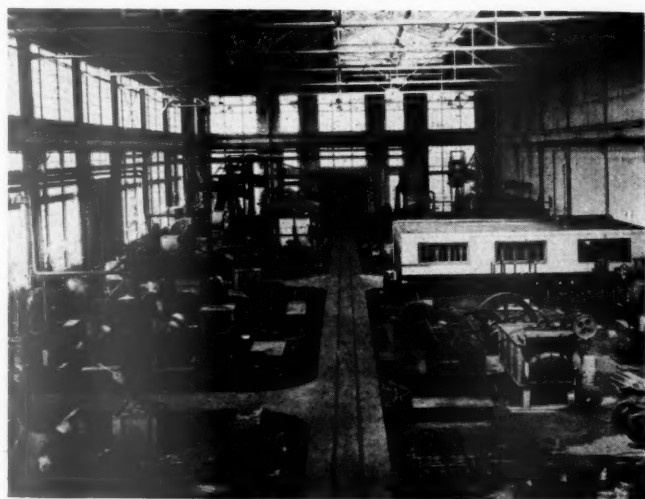
Electric overhead crane service has been well provided for without being overdone; that is, without placing too many cranes on one runway. Stationary jib cranes have been installed at all points where deemed necessary, to take care of a large number of minor lifts, thus leaving the electric cranes more freedom to perform their proper functions without unnecessary delays. Eleven electric travelling bridge cranes and three wall-bracket type travelling cranes are in operation, distributed throughout the plant as follows: Erecting shop,



Auxiliary equipment bay which is located in front of the erecting shop showing the air brake repair department; jacket and tin shop; superheater and feedwater-heater repair shop and the flue shop

one 200-ton crane and one 40-ton crane on the upper runway. The latter crane is for use principally in the boiler shop. There are also two 15-ton messenger cranes on the lower runway. The heavy machine bay has two 15-ton cranes; the tank shop, one 40-ton crane; the truck shop, one 15-ton crane; the miscellaneous bay, one 15-ton crane; the forge shop, one 10-ton crane; the riveting tower, one 25-ton crane, and the light machinery bay, three one-ton wall-bracket travelling cranes controlled from the floor and serving work benches, etc., in the rod, motion, axle, box and millwright departments.

All of these cranes have the latest features and equipment, and with the exception of the wall-bracket cranes have central lubricating systems. Load lowering is ac-



The forge shop showing some of the oil-gas forge furnaces—Two Whiting 3-ton electric operated self-supporting cranes are shown in the background

complished by regenerative braking. All are operated with d.c. current except the 25-ton crane in the riveting tower, which is a.c.

The design of the 200-ton locomotive lifting crane is rather unique, in that it is supplied with a third or 10-ton auxiliary hoisting trolley which operates on the main bridge between the two main trolleys. This arrangement has proved to be an improvement over the usual system of adding auxiliary hoists on the main trolleys, where they are out of action during the lifting, wheeling or un-wheeling of locomotives.

The third trolley has a longitudinal travel equal to the distance between the main trolleys. A cross travel of 15 ft. 2 in. allows the use of the 10-ton auxiliary hook for the removal or replacement of main and side rods on either side of the locomotive or for other purposes while the locomotive is suspended on the main hooks. This crane has four-point suspension and is also arranged to lift locomotives high enough to pass over the 15-ton cranes on the lower runway.

Piping

Special attention has been given to the installation of the various pipe services with the object of reducing to a minimum leakage losses and maintenance costs. All piping with the exception of the drinking-water lines have been welded in. All valves or other fittings above 2 in. are flanged, with the mating flanges welded to the pipe. In addition, all short bends, elbows, tees, reducers, Y's, or other odd shapes were cut from the straight pipe with the torch and welded in. Manifolds for air-hose connections were made in the same way.

The various services originating at the power house are brought into the shop through a tunnel which extends across the width of the building. From the supply mains in this tunnel branches or risers are brought up at either the outside walls or at the various building columns. From these risers, the service lines are distributed overhead along the face of the columns on standardized brackets and clips.

Drops are carried from the service lines down at the building columns or walls where necessary for compressed air connections, fire hydrants, water and steam to engine pits and cleaning vats, water to drinking fountains and urinals, oxy-acetylene services, etc. All live steam and return lines are insulated. The drinking-water service pipes have anti-sweat and temperature coverings. In addition the entire piping installation has been painted in a color scheme which has been adopted as standard for the Canadian National System. The completed piping installations presents an appearance which for neatness and accessibility would be difficult to improve. Following is a list of the standard colors adopted:

Standard Colors for Painting Pipes

PIPE LINE	COLOR
Acetylene	Bright red
Oxygen	Pea green
Live steam	Bright yellow
Exhaust steam	Light brown
Vacuum lines	Dark drab
Air lines	Dark lead
Drinking water	White
Hydraulic lines	Light blue
Washout lines	Dark blue
Plant water	Green
Oil lines	Black
City gas	Dark red
Gasoline	Orange vermillion
Electric conduit	Aluminum

Floors and Machine Foundations

Generally speaking, the floors are wood blocks laid on a reinforced-concrete sub-floor. The exceptions are the



Section of the light machine bay, the brass and bolt departments—The tool room is located beneath the foremen's offices shown in the background

forge shop, which is cinders with concrete trucking roads, the spring shop, which is concrete, and the tank shop, which is also concrete laid with drainage slopes to carry away spillage water, etc. There is also a small area of cinder floor around the flange furnace and press in the

boiler shop to take care of hot plates. An area of concrete is used in the tube and flue shop around the tube cleaning machines where water would be detrimental to the wood blocks.

All machine tools rest on concrete, the foundations being of a widely varying nature to suit the type and weight of machine. Foundations for the larger machines requiring anchor bolts, pits, etc., were located from the machine tool layout, formed up and poured in advance of the sub-floor slab. Separate foundations for all the lighter types of machines were dispensed with, the sub-floor slab being thickened where required to support machines by bringing the concrete up to normal floor level. This arrangement also provided sufficient thickness for concrete foundations to take care of light anchor bolts where such were necessary.

The Heating System—Miscellaneous Services

Heating the entire building is accomplished by a system comprising a total of 81 unit heaters of the high-ceiling type. Each unit is operated by a 2-hp. motor and is supplied with exhaust steam at 5-lb. pressure. Under normal operations about 50 per cent of the unit heaters are thermostatically controlled, the remainder having manual control and only sufficient of the latter are cut in to maintain a shop temperature of 65 deg. F.

All heaters are hung in the roof trusses, with heated



The erecting shop looking toward the boiler shop—The 200-ton crane with the 10-ton auxiliary hook is shown in the top foreground

air discharging slightly above the lowest chord of the truss. In the erecting bay, the warm air discharge is therefore more than 56 ft. above floor level while in the remainder of the building it is more than 35 ft. above the floor level. No difficulty was experienced during the past winter in maintaining a uniform temperature during all conditions of weather.

As may be observed from the machine-tool layout, trucking aisles or traffic lanes have been laid out which provide access to and permit convenient trucking service to all parts of the shop. All movement of material not taken care of by overhead electric cranes, is made by power trucks using trailers where necessary. These trucking aisles are outlined on the floor by white painted lines.

Washroom and toilet facilities for the men are in-

cluded in a combination structure with the foremen's offices in the forge shop, boiler shop and tender shop. The erecting- and machine-shop facilities are housed in a two-story structure about midway of the light machinery bay. Washrooms are equipped with Bradley wash fountains and metal lockers. The foremen's offices have separate facilities. Drinking fountains are located at convenient intervals throughout the shop area. This also applies to urinals.

Petty stores in the boiler and tender shops occupy the ground floor under the foremen's offices and washrooms. The machine and erecting shops are served from a combined tool store and petty store which are centrally located in the heavy machine bay. The tool store is equipped with the necessary grinding tools for sharpening reamers, taps, twist drills, small milling cutters, and lathe, planer, and shaper tools, etc.

Outside the building and entirely surrounding it at a distance of 17 ft. from the wall is a 20-ft. concrete roadway having curbs and gutters. This roadway connects at all outside doorways and also links up with the main stores and city streets. Eventually, when all projected shop units are complete, it will not be necessary to leave the pavement in order to deliver material to and from any of the buildings or stock storage spaces in the entire plant.

At the east end of the shop, convenient to the shop service tracks, will be located the dead locomotive and tender storage yard. This yard will include a ladder track with short spurs for the convenient handling of tenders. Other facilities included in this yard will be a 100-ft. turntable and a 50-ft. by 270-ft. firing-up and inspection shed, which has two tracks with pits and an overhead electric travelling crane, also, a locomotive weighing scale will be added to the equipment in this building.

Present Production and Forces

Although the new shop has been in operation only a comparatively few months it has been producing an average of 36 class repairs per month at a cost of \$1.00 per unit. The unit system of measurement of production and costs, which the Canadian National has evolved, is effective at all the larger repair shops, and is based on the possible productivity of equipment and forces per 100 man-hours worked. Approximately 1,173 men, clerks and supervisors are employed in locomotive repair work at the Point St. Charles shops. Of this force, 112 are employed in the blacksmith shop, 258 in the erecting shop, 301 in the machine shop, 181 in the boiler shop and 93 in the tender shop.

The foundry, which is operated in connection with this shop, turns out all kinds of grey-iron castings as large as locomotive cylinders.

The Point St. Charles shop handles part of the locomotive class repair work for the Central Region of the Canadian National System. All repairs are scheduled under the direction and supervision of the general superintendent of motive power and car equipment of the region and his staff. All new power is built under the direction of the chief of motive power and his staff. New standards are also developed and approved by the office of the chief of motive power. Shop methods and systems are prepared by the general supervisor of shop methods.

The shop superintendent reports to the superintendent of motive power and car equipment of the Central Region. He meets once a week with the general foremen and the seven shop foremen who arrange the scheduling of locomotives through the shop. This staff meeting

(Concluded on page 130)

Draft Gears for Passenger Cars

Abstract of a paper presented
before the January meeting
of the Pueblo Car Men's
Association

By C. T. Ripley

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WHEN the question of passenger-car draft-gear design was studied a few years ago, little or no published test data were found. Consequently, systematic study both in the laboratory and on the road was started. The manufacturers also lacked basic data and none of the gears then on the market fully met requirements. The manufacturers co-operated in every way in the experiments and, since that time, a number of them have developed gears to meet the requirements. In considering these requirements, it is necessary to review the developments and operating conditions that had to be met.

The draft gear as applied to all equipment is used to protect lading and equipment against damaging shocks and only in recent years has the influence on train handling and train riding become generally recognized. In times past the track, or the trucks have usually been blamed for any disturbance in the car, so that even men who were well versed in draft gears were free to state that the draft gear could not be blamed for bad riding, but these same men were unable to explain how a change of draft gears only corrected a bad riding condition. Thus it is that another factor must be considered as contributing to the discomfort of passengers; namely, the rapid jerking or surging of the train, caused by the locomotive and transmitted by draft gears not properly designed for the service.

In this connection, we must first consider the reciprocating engines of the locomotives where only a part of the reciprocating weight is counterbalanced. As a result, these reciprocating weights are cushioned by steam compressed in the cylinders and the locomotive frame gets the reaction. This results in two components, one forward and one backward, for each wheel revolution, and produces distinct jerks that depend on speed and also on the moving mass. The bad effect, as on the riding of trains back of Mountain-type locomotives, due to reciprocation impulse, is most critical at 27 m.p.h., and practically disappears below 18 and above 35 m.p.h.

In this country the early draft-gear development consisted of spring arrangements, either single or in parallel or in tandem, depending on the weight and construction of the cars and locomotive. As the size of equipment and trains increased, draft gears of higher capacity were developed in the form of friction gears. The friction gear has a high absorption which shows an area between the compression and release curves with the result that, after a pull of 60,000 lb. at the drawbar, the gear may

not release until the load has dropped to 4,000 or 5,000 lb. With this kind of gear, the pull might fluctuate between 60,000 lb. and 20,000 lb., with an average of 40,000 lb., and the gear show little or no action, but behave like a solid block.

Draft Gears Should Dissipate Locomotive Surging

As a result, the power impulses of the locomotive are transmitted by this gear to the car back of it, and an unpleasant surging may result. With a properly-designed spring and friction combination gear, the spring will compress and release one inch or so for each driver revolution under the same conditions, and the surging is dissipated in the gear instead of in the car mass, where it annoys passengers.

The Class G tandem spring meets some of the requirements, but does not have the overload margin necessary for heavy equipment. As the friction gears came to replace the spring gears, it was only natural that they should retain $\frac{1}{2}$ in. to $\frac{3}{4}$ in. of preliminary spring travel, closing at 20,000 lb. or 25,000 lb. and then going into friction. This was fairly satisfactory for a time while the spring was new and stiff and the friction element soft, but constant use produced permanent set in the spring and stiffened the friction action, with the result that the smooth, easy changeover in the compression curve became angular or sharp. The gear action then changed and had the equivalent of free slack and very high resistance, and locomotive surging was transmitted to the first car and, in many cases, to the second car and beyond.

The need for greater gear capacity resulted in using a pair of springs combined in a gear housing with $\frac{3}{4}$ in. of spring travel and $1\frac{3}{4}$ in. of friction travel in one certain type of gear. Within certain train limits this arrangement was quite satisfactory, but with one or two cars added, there were considerable periods of jerking as the elastic travel range was not enough to take care of the normal train range. The spring travel was then increased to $1\frac{1}{4}$ in. and the friction travel decreased to $1\frac{1}{4}$ in. This was a decided improvement but, in an effort to get 60,000-lb. spring resistance, the initial pressure was raised to about 18,000 lb. This was all right for the heavier trains, but for light trains there was little or no spring movement, especially in drifting when

the engine brakes were released with train brakes on, resulting in considerable roughness of surging.

The analysis of the various relations resulted in drafting the general specifications which follow; that is, a gear with tandem-spring characteristics for $1\frac{3}{4}$ to 2 in. of travel and either friction or high spring capacity for the last $\frac{3}{4}$ in. to 1 in. of travel:

Size—The draft gear shall fit the standard A. R. A. pocket $9\frac{1}{8}$ in. by $12\frac{3}{4}$ in. by $24\frac{3}{4}$ in. when used with the necessary standard follower plates wherever the gear design requires these plates.

Travel—The draft-gear travel shall be not less than $2\frac{1}{2}$ in. nor more than $2\frac{3}{4}$ in. as prescribed by A. R. A. for freight draft gears.

Capacity—The slow load capacity at $1\frac{3}{4}$ in. shall be from 60,000 lb. to 70,000 lb., the loading curve being a straight line, or a long radius curve. From $1\frac{3}{4}$ in. travel to closure, the slope of the line shall change so that the capacity shall be at least 150,000 lb. at gear closure. The change of direction of lines shall be a smooth curve.

Initial Compression—The initial compression shall be not less than 3,000 lb. nor more than 5,000 lb.

Sturdiness—The construction shall permit a number of oversolid blows under the drop hammer with 600,000 lb. sill-pressure without appreciable housing, shorting or distortion.

Characteristics—The draft gears shall have coil-spring action from initial to $1\frac{3}{4}$ in. and show little or no hysteresis loss between compression and release curves under slow loading. The travel from $1\frac{3}{4}$ in. to closure may have friction characteristics with accompanying absorption, as indicated by the separation of compression and release curves, but shall show no creeping under repeated slow loading and partial release. The action throughout the entire travel shall be uniform as to travel and sill pressure, and the gear shall be so constructed that the last drop just under closure shall produce not more than 350,000 lb. sill-pressure when measured with an Endsley dynamometer, or a chronograph, or similar dynamic pressure indicator.

Construction—The gears shall be essentially self-contained, so that each gear can be applied and removed as a unit exclusive of not more than two standard separate follower plates and the gear characteristics shall not change appreciably in service.

Several manufacturers developed passenger-type draft gears, complying in general with these specifications. These gears resulted in further improvements in train riding, but perfection in riding at all times is even yet not obtained. With 13 to 14 cars on the trains, instead of 10 to 11, the drawbar pull is increased enough sometimes to be beyond the spring travel into the friction travel and cause some jerking on a few of the heavier grades. The handling of a baggage or mail car between locomotive and head passenger-carrying car gives the necessary cushioning so that good riding results in the next car and beyond.

The older design of friction gears consisted of a malleable iron barrel and case-hardened shoes. In recent years, this has been changed to cast steel heat-treated housings and either cast or drop-forged shoes, also heat-treated, to give increased wear. The general tendency is to use high capacity draft gears for the back end of the locomotive tenders, which includes a limited travel and also inflexibility for passenger as well as for freight service. Some experiments with locomotives equipped with passenger style draft gears have shown a good influence on the riding of the train, as it gives added flexibility and there is a greater absorption of power impulses, and smoother riding of the train results.

Tests Made With Dynamometer Car

The method of determining the riding qualities of equipment may be of interest. Some of the data were obtained by using a dynamometer car for a complete operating record. This produced a special case that is not representative of everyday operation. This was supplemented by placing recording instruments in the baggage end of the buffet car for several trips, and getting a record of the draft-gear movement relative to the locomotive tender; also the speed and the drawbar stretch and a record of the riding each minute, or each five minutes. This gave a lot of basic data as to the relation of gear action and car riding, but was limited in its application.

Further investigations were made by using a heavy pendulum connected with a clock-driven paper so a record was obtained of the vibration or car movements. Such a pendulum would record only in the direction of

its swing and, as disturbances occur in any one of the three dimensions or components of these, it is not adequate. Bad riding may be due to the backward or forward motion as caused by locomotive power impulses, and brake applications, the up and down movement due to wheels, springs, equalizer, track, etc., and the sidewise motion due to conditions such as the flanges hugging the rail and also due to track irregularities, and various speed factors, depending on operating conditions.

In the absence of a satisfactory riding recording device, we have made such observations as will give comparative data affecting the passengers in the cars, as to whether they seem comfortable or restless, and in order to have a comparative record the observer uses a notebook and draws a series of short vertical or diagonal lines that may be independent or connected as follows: ////////////// or NNNNNN. For smooth riding, these lines are quite uniform, but for rough riding, they become comparatively rough or irregular, but naturally it requires experience on the part of the observer to trace the probable cause. A car can be checked fairly well in two or three minutes, which permits a record of all the cars under practically the same operating conditions.

Rough Riding Often Psychological

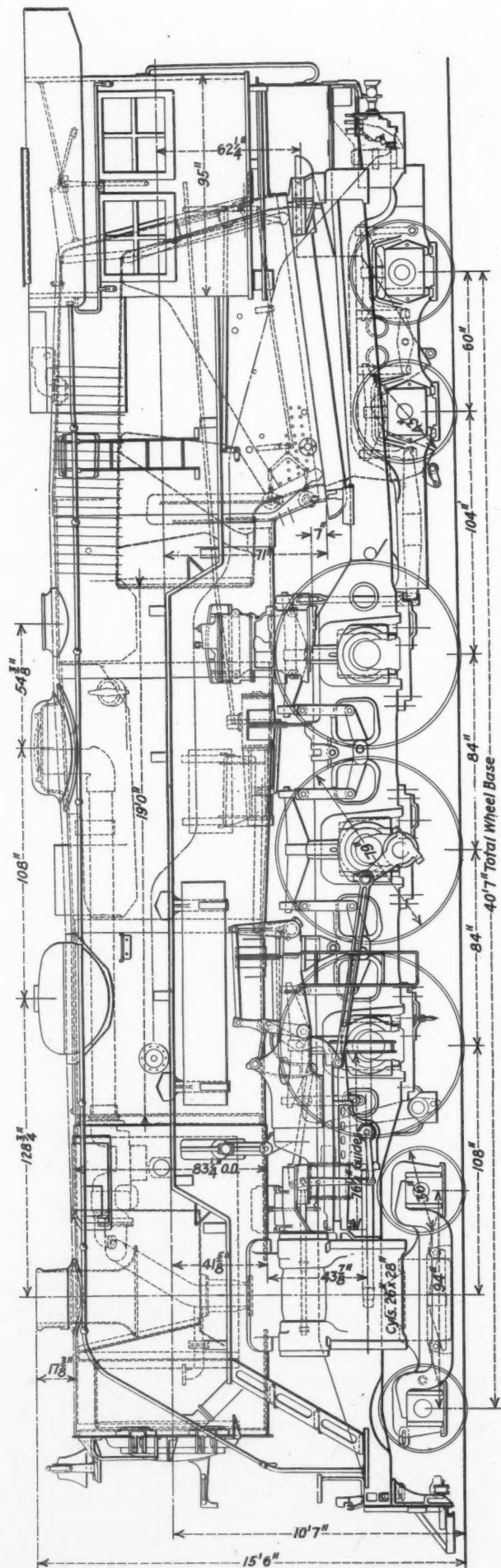
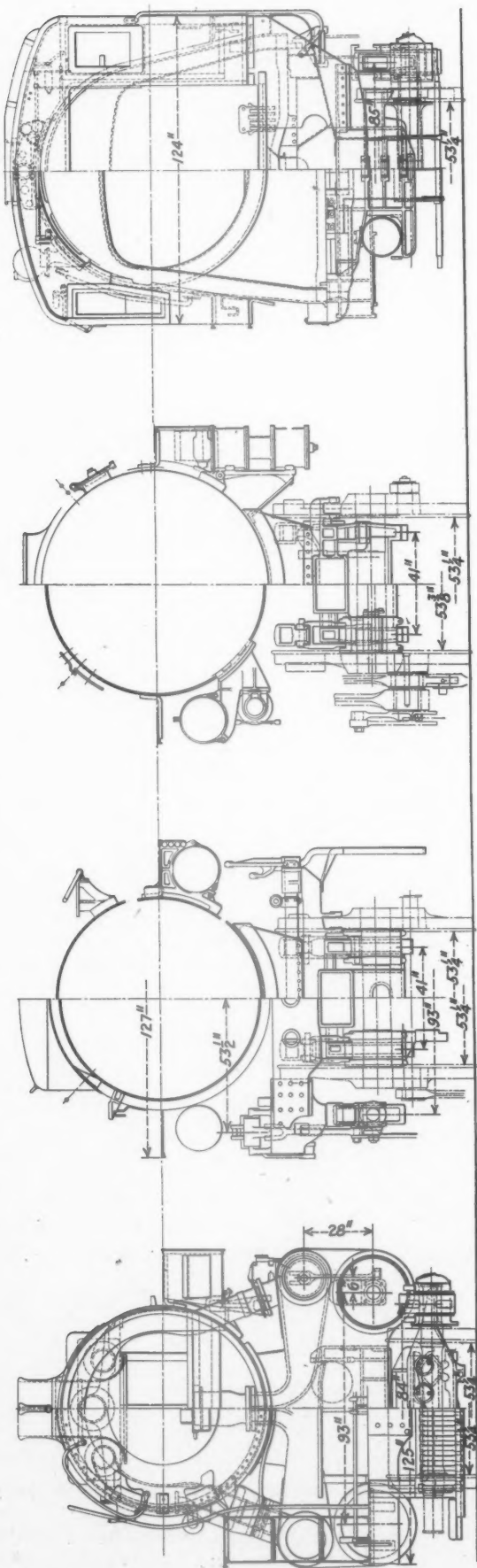
Rough riding with passengers is often psychological, in that they will associate noise with roughness, so that a noisy coupler, vestibule curtain, a loose window, radiator pipe or light fixture, will disturb passengers and cause them to complain of rough riding, while actually the cars are running as smoothly as any others in the train where there is no complaint. Likewise the dining cars and buffet cars are subject to complaint, because the handling of a cup of coffee or a spoon of soup, or the writing of a letter, are operations that require more favorable conditions than a nap on a soft seat or cushion in a Pullman car. On long transcontinental rides, the passengers frequently have little else to do except to observe service and have time to comment on it.

The draft gear is a factor in smooth starting and stopping of trains. When the train cushions on springs between cars, the stop is smoother than when the action is against a high-capacity friction draft gear. In starting with spring gears that can be compressed $1\frac{1}{4}$ in. to $1\frac{1}{2}$ in. by the locomotive taking slack, the gear compression actually helps make easy starts, while with high-capacity friction gears that will move only slightly under the same conditions and have little or no recoil or storage capacity, there will be rougher starts and jerking of the train.

The maintenance of the draft gear is a serious problem, as even close inspection may not reveal the serviceability of the gear. A portable test machine has recently been developed, air operated, that weighs about $1\frac{1}{2}$ tons, rolls on the standard track and, when fastened to the car, makes a record on a sheet of paper showing the draft gear action. Such a machine is an aid in the inspection and maintenance of draft gears, and it is expected that a draft-gear test of both ends of a car can be made by two men in 15 or 20 minutes.

From this it will be seen that the passenger draft-gear requirements are quite different from the freight-car requirements, the passenger gear being primarily for comfort with sufficient strength to stay operative under moderately heavy shocks, while the freight gears are for protection against shock with little or no consideration for slight vibration, as there are no passengers to complain of surging.

(Concluded on page 130)



Cross section and elevation of Chicago, Milwaukee, St. Paul & Pacific 4-6-4 type locomotive

The trailing truck, which has a Commonwealth cast-

A list of the special equipment applied to these locomotives is shown in one of the tables. All the locomotives are equipped with type E superheaters, Coffin feed-water heaters, Standard modified type B stokers, three

List of Special Parts, Appliances and Equipment Applied on the Chicago, Milwaukee, St. Paul & Pacific 4-6-4 Type Locomotives

Railroad	Chicago, Milwaukee, St. Paul & Pacific
Builder	Baldwin Locomotive Works
Service	Passenger
No. built	14
Firebox and Boiler:	
Blower fitting	Barco
Blower nozzle	T-Z Railway Equipment
Blow-off cocks	Bird-Archer
Boiler and firebox steel	Bethlehem
Boiler jacket	American Sheet & Tin Plate
Feedwater heater and pump	Coffin
Fire brick arch	American Arch
Firedoor	T-Z Railway Equipment
Firedoor flange	O'Connor
Flexible staybolts	Alco
Flexible staybolt material	(7) Ewald and (7) Lockhart
Gage holders	Swanson
Injectors	Hancock
Injector checks, one side	Hancock
Injector checks, one side	Prime
Lagging	Johns-Manville
Safety valves	Consolidated
Smokebox hinges	Okadee
Smokebox netting	Draftac
Smoke prevention nozzle	T-Z Railway Equipment
Staybolts, hollow	Ryerson
Staybolts, solid	Lockhart
Steam gage	Ashton
Steam pipe casing	Alco
Stoker	Standard, modified type B
Stoker steam gage	Ashton
Superheater	Type E
Syphons	Nicholson Thermic
Syphon staybolt material	Ewald
Syphon steel	Otis
Throttle	American
Tubes and flues	Globe Seamless, National, and Pittsburgh Steel
Washout plugs	T-Z Railway Equipment
Water column	Prime
Water glass	Libby
Water glass guard	Sargent
Whistle	Hancock
Cylinders and Running Gear:	
Bed frame	Commonwealth
Crank pins	Standard Steel
Connecting rods	Carbon steel
Cross head shoes	Hunt-Spiller
Cyl. and valve bushing	Hunt-Spiller
Cylinder cocks	Hancock
Cylinder lubricator	Nathan
Cyl. and valve packing	Hunt-Spiller
Driving axles	Standard Steel
Driving box lubricator	Franklin
Driving tires	Railway Steel Spring
Engine truck frame	Commonwealth
Engine truck wheels	Standard Steel
Piston heads	Carnegie
Piston rods	Standard Steel
Reverse gear	Alco
Springs	Railway Steel and Union.
Spring material, engine, trailing and tender trucks, driving	Chrome-vanadium
Trailing truck frame	Commonwealth
Trailing truck roller bearing units	American Steel Foundries (Timken)
Valve gear	Baker
Cab and Miscellaneous:	
Air brake piping	A. M. Byers
Brakes	Westinghouse 6-ET
Brake, foundation	American WM-3
By-pass valves	Whelan
Cab windows	Prime
Cab windshield	Prime
Cocks and valves	Hancock
Coupler, engine	Buckeye
Draft gear	Miner
Flange lubricator	Hoofer
Front bumper	Commonwealth
Headlight	Pyle-National
Headlight wiring	Kerite
Lubrication	Alemite
Radial buffer	Franklin
Safety bar	Franklin
Sanders	T-Z Railway Equipment
Speed recorder	(2) Hasler (R. W. Cramer & Co.)
Steam heat regulator	Leslie
Tender:	
Engine and tender connections	Barco
Tender coupler	Buckeye
Tender frame	Commonwealth
Tender truck	Commonwealth
Tender truck roller bearing units	Timken
Tender truck side bearings	Stucki

Thermic syphons, Alco power reverse gear, train control and one-piece Commonwealth cast-steel cylinders and bed.

The tender is of welded construction and is carried on two six-wheel trucks equipped with Timken roller bearings. It has a water capacity of 15,000 gal. and a fuel capacity of 20 tons.

Point St. Charles Shops of the Canadian National

(Continued from page 124)

is followed by a meeting of the gang leaders with their respective foremen, who make further detail plans pertaining to the shop schedule. Competitive costs and efficiency records between departments are kept up-to-date, which tends to keep the shop foremen and gang leaders on the alert for efficient departmental production.

As is well known among railroad men, the Canadian National handles its equipment maintenance work on a cooperative plan with the shop unions by which agreement piece work is abolished and each man is allowed one week's vacation with pay. It is reported that this system is working satisfactorily from both the standpoint of production and morale. The company maintains an athletic association which supports various sports, and teams competing with representatives of local clubs.

Detail descriptions of the equipment, arrangement and methods used in the various departments of the Point St. Charles shop will appear in future issues of the *Railway Mechanical Engineer*.

Draft Gears for Passenger Cars

(Continued from page 126)

Some entirely new principles of passenger car draft gears are now being experimented with in this country. One of these is a European-type in which the draft connections run the full length of the car between the sills. With this design, it is possible to get sufficient capacity without any friction elements, that is, it is all spring action. Another type is the English rubber gear in which the elasticity of rubber gives the cushioning effect.

In locomotives the tendency has been high-capacity heavy-duty draft gears because the loss of the draw-bar at the back of the locomotive means a locomotive failure, on either passenger and freight locomotives. However, the draft gears that meet the passenger specification should also be satisfactory for the locomotive tender, and the power loss due to the flexibility is probably less than the loss due to jerking of a very stiff gear.

There are railroads in America with grade, train and speed conditions such that they may, perhaps, not need to be so careful of the choice and maintenance of their passenger draft gears, but on the Western roads with their wide range of operating conditions, the use of proper passenger draft gears and their proper maintenance becomes a vital problem in the satisfactory handling of passenger trains, particularly those in which passenger-carrying cars are near the head end. The manufacturers have done most commendable work in improving their designs to meet these conditions.

"A SAVING of \$145,000 a day accrues to the railroads of the country through the present practice of using chemically treated timber for cross ties and other purposes," said C. C. Cook, maintenance engineer of the Baltimore & Ohio, at a conference of the public utility group of The National Association of Purchasing Agents, held at the Department of Commerce in Washington on January 23. Mr. Cook addressed this meeting as a member of the National Committee on Wood Utilization of the Department of Commerce.



C. & E. I. 2-10-2 locomotive equipped with Hulson Tuyere-type grates for burning 1¼-in. screenings on test run

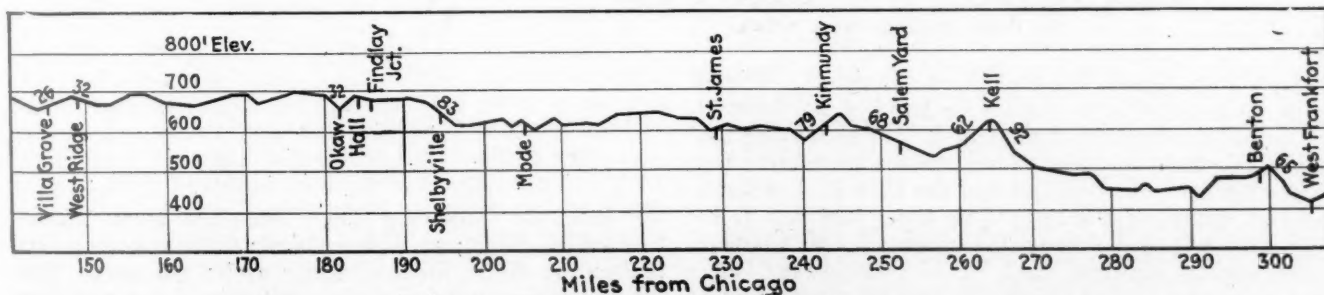
Screenings Successfully Burned in C. & E. I. Road Test

Gave high firebox temperatures—Were 97.3 per cent as efficient as mine run on gross ton-mile basis, but other factors favor screenings

THE Chicago & Eastern Illinois recently conducted some carefully supervised road tests of steam locomotives which demonstrated that, with mechanical stoker equipment and Hulson Tuyere type grates, it is entirely feasible to burn 1¼-in. screenings at slightly reduced efficiency as compared with mine-run coal. The tests showed that, considering coal as purchased by weight, 1¼-in. screenings are 97.3 per cent as efficient, on a gross ton-mile basis, as run-of-mine coal from the same mine in Franklin county, Southern Illinois. On an evaporation basis the screenings are 92.6 per cent as efficient.

One of the tables shows the comparative values of both grades of coal burned, from an evaporation standpoint and on a gross ton-mile basis, separated as between northbound and southbound trips, and for the combined

trips. From the standpoint of pounds of coal per 1,000 gross ton-miles, screenings seem to be more efficient than mine-run on southbound trips, but less efficient on northbound trips for some unexplained reason. On account of the tonnage available, the locomotive handled a total of 95,535 more gross ton-miles, or 4.12 per cent, with screenings than with mine-run coal, which may have had some bearing on the unit fuel-consumption figures. The differences in efficiency on the evaporation and on the gross ton-mile basis were largely due to increased steam consumption in operating the stoker with mine-run coal. While the tests indicate that screenings are not quite as economical as mine run from an efficiency standpoint, there are other factors which must not be overlooked, including the reduced wear on stoker machinery, less labor for handling screenings at coal



Condensed profile of the C. & E. I. line on which the fuel test runs were made

chutes and lighter fuel beds which reduce the time and labor required at cinder pits.

Other conclusions drawn were that C. & E. I. 2-10-2 type locomotives 2000 to 2006, one of which was used in the tests, are satisfactory for fast-freight service; that no change in draft arrangement is required to burn screenings, as compared with mine run; that practically complete combustion, freedom from smoke, minimum stack and ash-pan loss are assured; that higher firebox temperatures, up to 2,500 deg. F., with screenings will subject the firebox sheets to harder service; that the proper valve setting for these locomotives in fast-freight service is 3/16-in. lead and 1/8-in. exhaust clearance;

Analysis of Coal Used in the Test Runs

	Screenings	Mine run
Water	3.12 per cent	6.36 per cent
Ash	11.56 per cent*	6.26 per cent
Volatile	21.08 per cent	37.32 per cent
Fixed carbon	64.24 per cent	48.89 per cent
Sulphur	1.77 per cent	1.17 per cent
B. t. u. per lb.	11,646**	11,940**

* Sulphur is included in ash percentage.
** B. t. u. values based on coal as received.

that a power reverse gear providing accurate and fine adjustment of the cut-off, permitting operation with a wide-open throttle, is essential; that the locomotive will travel 4.94 miles per 1,000 gal. of water, based on the average of northbound trips, or 4.37 miles per 1,000 gals. of water, based on the maximum amount used on

Table Showing Maximum Temperatures (Deg. F.) Reached at Various Points in the Locomotive

	Screenings	Mine run
Firebox, under the arch	2500*	2440
Between arch and door sheet	2020	1950
In combustion chamber	1930	1900
Smoke box—Back of defl. plate	600	600
Smoke box—Front end	510	510

* At this temperature the pyrometer couple burned off.

any trip. Subsequent tests showed that screenings from other parts of Illinois and Indiana can be burned in locomotive service with successful results.

Method of Making Tests

The tests were conducted in regular road freight service, southbound and northbound, on the C. & E. I.

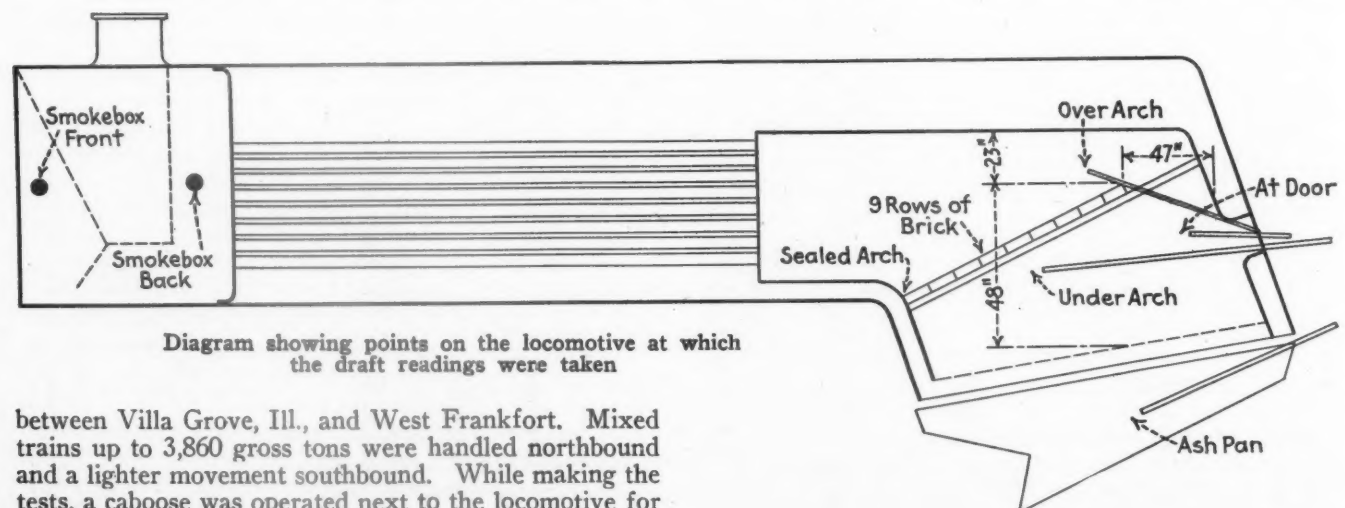


Diagram showing points on the locomotive at which the draft readings were taken

between Villa Grove, Ill., and West Frankfort. Mixed trains up to 3,860 gross tons were handled northbound and a lighter movement southbound. While making the tests, a caboose was operated next to the locomotive for the convenience of observers and the C. & E. I. officers in direct charge of the test. The latter included J. F. Lord, assistant to the general manager; E. M. Cooney, motive power inspector, and S. A. Schickedanz, mechanical engineer, who personally took all readings and supervised all changes and adjustments made on the lo-

comotive. A representative of the Hulson Grate Company, Keokuk, Ia., and a lubrication expert from the Sinclair Oil Company accompanied all of these test runs for purposes of observation.

All measurements of coal and water consumption were made with the greatest practicable accuracy; as were also steam pressure, back pressure, draft readings and firebox and smokebox temperatures, the latter being secured by means of a pyrometer furnished by the Superheater Company. A total of 10 one-way trips were made burning screenings and six one-way trips burning mine-run coal. Because the test locomotive was just out of the shop and was not fully broken in, a number of adjustments were required before giving satisfactory performance. Therefore, the first two round trips, burning screenings, have been eliminated from consideration, leaving six one-way trips with each grade of coal.

The 2-10-2 type locomotive, No. 2006, with which the

Average Unit Coal and Water Consumption (Coal as Fired)

	Lb. water (as measured) per lb. of coal	Lb. water (equiv. evap.) per lb. of coal	Lb. coal per m.g.t.m.
Screenings			
Southbound	4.98	6.12	153
Northbound	5.36	6.58	93
Both ways	5.19	6.37	113
Mine Run			
Southbound	5.52	6.79	164
Northbound	5.76	7.07	87
Both ways	5.65	6.94	110

tests were made, develops 71,900 lb. tractive force with a steam pressure of 185 lb., but in this test the steam pressure was raised to 195 lb. The locomotive weighs 290,800 lb. on the drivers, has 30-in. by 32-in. cylinders, 132-in. by 96-in. firebox and is equipped with a Baker valve gear, power reverse gear and Duplex stoker. This locomotive received the following changes at the shopping referred to: The valve setting was changed from 3/16-in. lead and line-in-line exhaust clearance to 1/8-in. lead and 1/16-in. exhaust clearance. The lead was subsequently again increased to 3/16 in. The barrel-type netting and spark arrestor were removed from the smokebox and the Master Mechanics' front end applied with the extension stack.

By means of a 12-in. Ellison draft gage located in

the cab, the following draft readings were taken: Smokebox, front; smokebox, back; firebox, over arch; firebox, at door; firebox, under arch; ash pan. The draft or vacuum from the smokebox and ash pan was piped to the cab, and connections were made with the

draft gage by means of a flexible hose. Draft readings in the firebox were obtained by projecting a 8-ft. section of the pipe, connected to the draft gage by a flexible hose, into the firebox through the fire door. Draft and temperature readings were taken only on the first two trips with screenings and the first two trips with mine run.

The firebox and smokebox temperatures were the tender off the locomotive at the end of each trip at

tain a counterbalance of 50 per cent of the reciprocating parts, this being greatly improved by the new rods. The brick arch was sealed at the throat sheet in the firebox.

Data and Readings

The amount of coal burned was determined by cutting

C. & E. I. Road Fuel Test* of Locomotive 2006 Equipped with Hulson Tuyere Type Grates, on 159 Mile Test Runs, Northbound and Southbound, Between Villa Grove, Ill., and West Frankfort

Test No.	Date	Kind of coal**	Total water (lb.)	Total coal (lb.)	Gross ton-miles	Condition of fire † depth	Amount of ash	Time en route (hrs. min.)	Total delay (hrs. min.)	Loaded cars (per cent)	Temperature (deg. F.)	Water (as measured)	Coal (as fired)	Ton-miles per train-hour	Av. boiler pres.	Equiv. evaporation ‡			
												Lb. per lb. of coal	Temp. (deg. F.)			Lb. per m.g.t.m.	Lb. per sq. ft. grate per hr.	Lb. of water	Lb. of water per lb. of coal
SOUTHBOUND (TRAIN NO. 155)																			
5	11-22	Sc'gs.	209,370	43,464	321,293	Good	1/4 full	6-0	0-45	53	28	4.82	37	135	82.1	53,549	190	257,483	5.92
7	11-24	Mine R.	192,038	33,960	237,186	Good	None	5-30	0-7	48	30	5.65	37	143	70.2	43,125	188	236,149	6.95
9	11-26	Mine R.	184,413	33,200	232,464	Good—4 in.	30 lb.	5-15	0-7	30	40	5.55	37	143	71.8	44,279	190	226,791	6.83
11	12-2	Mine R.	232,982	43,320	204,460	Good—10 in.	Little	5-50	1-0	22	10	5.38	36	212	84.4	35,252	190	286,777	6.62
13	12-4	Sc'gs.	189,130	37,032	166,898	Good—5 in.	Little	5-15	0-10	40	6 & 36	5.11	37	222	80.1	31,790	190	232,589	6.28
15	12-6	Sc'gs.	203,700	40,364	302,218	Good	Little	5-55	0-15	45	40	5.05	41	134	77.4	51,050	190	249,675	6.19
NORTHBOUND (TRAIN NO. 152)																			
6	11-23	Sc'gs.	280,570	55,556	525,613	Good	1/4 full	10-30	2-30	93	30	5.05	37	106	60.1	50,058	190	345,047	6.21
8	11-25	Mine R.	255,059	44,536	530,012	Good—12 in.	1/4 full	8-30	1-35	85	34	5.73	40	84	59.5	62,353	188	312,855	7.03
10	11-27	Mine R.	252,889	44,484	569,626	Fair	Little	7-45	1-10	90	45	5.68	42	78	65.2	73,500	190	309,713	6.96
12	12-3	Mine R.	303,301	51,884	515,731	Good—12 in.	Little	9-30	3-20	92	2 & 20	5.85	36	101	62	54,287	190	373,333	7.20
14	12-5	Sc'gs.	261,497	48,168	526,024	Good—7 in.	1/4 full	8-45	1-45	88	38	5.43	40	93	62.5	60,117	190	320,778	6.66
16	12-7	Sc'gs.	255,496	45,100	542,968	Good	Little	8-25	1-5	89	32	5.67	40	83	60.9	64,562	190	313,417	6.95

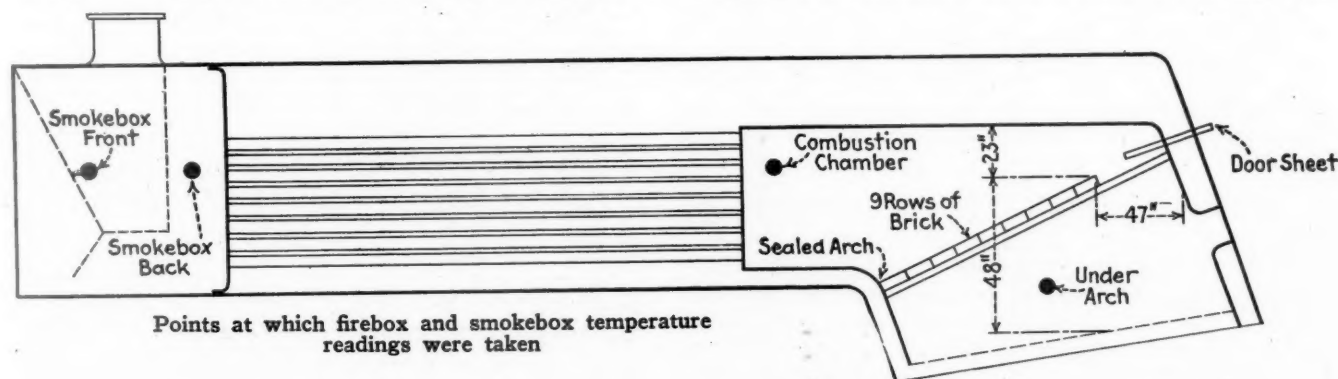
* Tests Nos. 1 to 4, inclusive, eliminated because the locomotive was not thoroughly broken in and final adjustments had not been made.
 ** 1/4-in. screenings, or run-of-mine taken from the same mine in Franklin county, Southern Illinois.
 † Fire condition at final terminal. Grates were shaken at intermediate terminals.
 ‡ Equivalent evaporation from and at 212 deg. F. (coal as fired).

measured by means of thermo-couples located in the smokebox and firebox. These were connected through a four-way switch to a pyrometer located in a cabinet in the gangway of the tender. From this pyrometer, the following temperature readings were obtained: Firebox, under arch; firebox, at door; combustion chamber; smokebox, back; smoke box, front.

An Elesco superheater pyrometer, located in the cab and connected to the left steam pipe above the valve chamber, gave the superheat temperature. An Ashcroft back-pressure gage, located in the cab, gave readings of

Villa Grove and West Frankfort and weighing before and after loading with coal. Enroute on each trip, coal was added at Salem from a weighed car. This car was reweighed after the coal had been applied to the tender, thus getting the weight of the coal added.

The amount of water evaporated was obtained by a measuring stick calibrated to show pounds of water in the tender for any depth of water. Measurements were taken at the beginning and end of each test and at intermediate points en route where water was taken. Deductions were made for water wasted in starting injec-

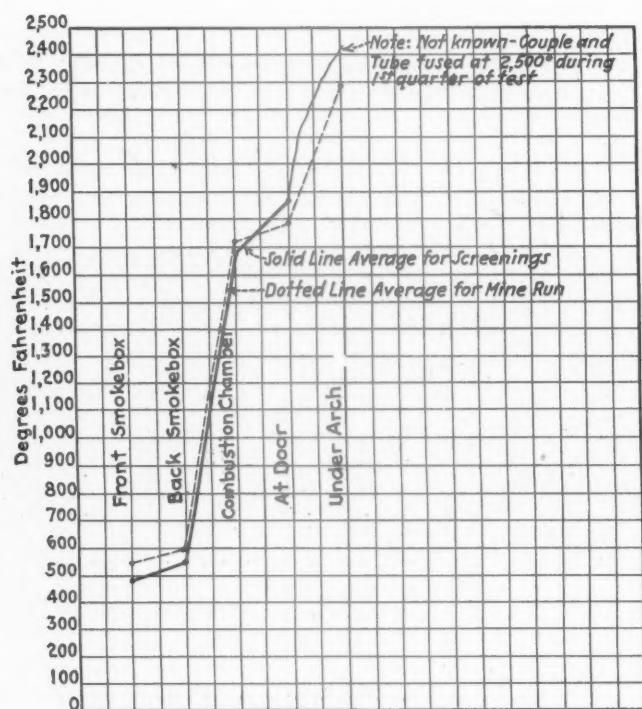


the steam pressure of steam entering the cylinder and the pressure of exhaust steam in the exhaust passages of the cylinder. Necessary data on tonnage were obtained to calculate gross ton-miles hauled on each trip. New main rods and new front intermediate side rods with floating bushings were applied, replacing old rods with solid bushings which had a tendency to run warm and were relatively heavier. Hulson Tuyere type grates were applied instead of original finger type. The counterbalance was carefully checked and adjusted to ob-

tors and water wasted by squirt hose in wetting down the deck of the locomotive and coal. The time safety valves popped was also obtained for deducting the steam wasted, in obtaining the fuel used on a g. t. m. basis. This figure was negligible and, therefore, not used.

Test Results

Practically no difference was noticed in the steaming qualities of the locomotive, using the screenings and the mine-run coal. The mechanical stoker and Hulson



Average comparative firebox and smokebox temperatures of Locomotive 2006

Tuyere type grates contributed to the good performance with screenings. The screenings burned in the same manner on this locomotive as on Mikado locomotives in previous tests. A considerable portion of the screenings seemed to burn in suspension, with a fuel bed about 4 in. or 5 in. deep, consisting of the larger pieces of coal from the screenings. With mine-run coal, less fuel seemed to burn in suspension; a somewhat thicker fuel bed was maintained, and the fuel bed gave

Draft in Inches of Water—Typical Readings Taken at Selected Points on Four Test Runs

Screenings	Smokebox		Firebox			Ash-pan	Speed m.p.h.	Gross tons
	Front	Back	Over arch	At door	Under arch			
Test No. 1								
Chipps	7.3	4.8	3.3	1.7	1.5	.15	33	1,806
Kimmundy	9.5	6.75	3.9	1.9	1.7	.15	25	1,745
Kenneth	6.9	3.9	2.7	.9	.7	.2	45	1,388
Whittington	9.4	6.4	3.7	1.5	1.3	.15	40	1,096
Average	8.3	5.5	3.4	1.5	1.3	.16	35	1,507
Test No. 2								
Ina-Bonnie	9.5	6.2	3.7	1.3	1.2	.1	40	3,353
Bott. Kell H.	10.0	6.2	4.7	1.6	1.5	.2	25	3,246
Top Kell H.	10.0	7.0	3.5	1.1	1.0	.2	12	3,246
Loogootee	6.3	4.1	2.6	.9	.9	.1	30	3,125
Fair Ground	8.7	6.3	3.5	1.5	1.3	.1	20	3,146
Cadwell	9.3	6.4	4.2	1.7	1.5	.2	35	3,500
Average	9.0	6.0	3.7	1.6	1.2	.15	27	3,274
Avg. for screenings	8.69	5.80	3.58	1.58	1.26	.155	30.5	2,264
Mine Run								
Test No. 7								
Chipps	7.4	4.7	3.1	1.6	1.4	.2	40	1,430
Kimmundy	8.0	5.8	4.2	1.8	1.6	.1	30	1,430
Kenneth	8.0	5.5	3.4	1.7	1.6	.1	40	1,713
Whittington	11.0	8.7	5.7	1.8	1.6	.1	35	1,538
Average	8.9	6.2	4.1	1.7	1.55	.12	36	1,560
Test No. 8								
Ina-Bonnie	6.2	3.7	3.0	1.2	1.1	.1	35	3,366
Bott. Kell H.	9.0	6.4	4.1	1.6	1.4	.1	20	3,366
Top Kell H.	7.0	5.0	3.7	1.6	1.4	.1	12	3,366
Loogootee	9.8	6.7	3.6	1.7	1.3	.2	35	3,400
Fair Ground	10.5	6.8	3.7	2.0	1.7	.15	45	3,400
Cadwell	9.6	6.3	4.5	2.2	1.8	.2	40	3,400
Average	8.7	5.8	3.76	1.7	1.45	.14	31	3,383
Avg. for mine run.	8.65	5.96	3.90	1.72	1.49	.135	33.2	2,641

the appearance of having more air openings, because of the larger pieces of coal. The air resistance through the lighter fuel bed with screenings was the same as with the heavier fuel bed of mine run coal.

No check was made of cinder loss but, from general observation, no increase of cinders thrown from stack was noted with screenings as compared with mine-run

coal. It was noted that with a strong wind more coal was blown from the tender when using screenings than when using mine-run coal.

Best results were secured with the stack extended to 13½ in. from the table plate and top of the exhaust nozzle; diameter of extension stack, 19¼ in. flared to 25 in. diameter at bottom; the diameter of nozzle 7 in.

Temperatures in Degrees Fahrenheit—Typical Readings Taken at Selected Points on Four Test Runs

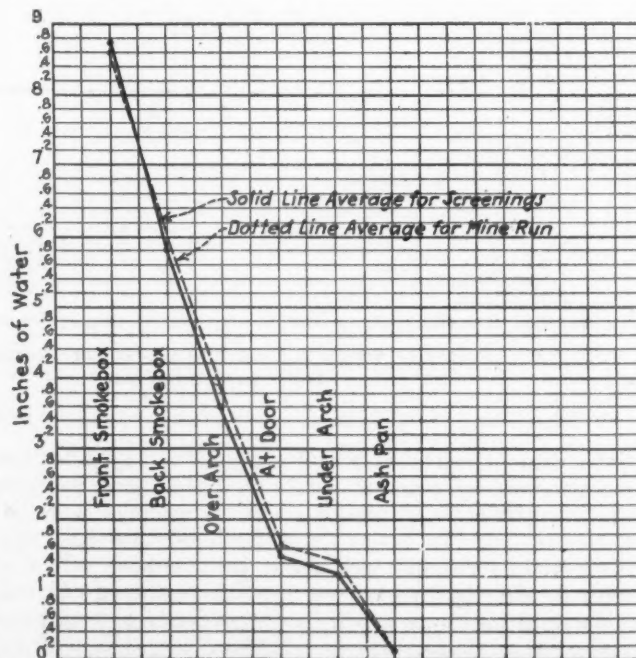
Screenings	Firebox			Smokebox		Super-heat.	Speed m.p.h.	Gross tons
	Under arch	Door sheet	Comb. chamb.	Back	Front			
Test No. 1								
Chipps	2,200	1,900	1,600	...	500	632	33	1,800
Kimmundy	2,190	1,620	1,600	...	500	640	25	1,745
Kenneth	...	1,825	1,620	530	...	650	45	1,388
Whittington	...	1,940	1,720	560	...	640	40	1,096
Average	2,195	1,821	1,635	545	500	640	35	1,507
Test No. 2								
Ina. Bonnie	...	1,920	1,620	560	...	650	40	3,353
Bott. Kell H.	...	2,020	1,900	600	...	650	25	3,246
Top Kell H.	...	1,900	1,810	570	...	650	12	3,246
Loogootee	...	1,750	1,650	560	...	640	30	3,125
Fair Ground	...	1,960	1,750	580	...	650	20	3,146
Cadwell	...	1,840	1,710	600	...	660	35	3,500
Average	...	1,899	1,740	578	...	650	27	3,274
Average for screenings	2,195†	1,867.5	1,698	570	500	646	30.5	2,264
Mine Run								
Test No. 7								
Chipps	2,230	1,830	1,720	...	510	630	40	1,430
Kimmundy	2,200	1,920	1,780	...	500	640	30	1,430
Kenneth	2,200	1,760	1,650	...	600	640	40	1,713
Whittington	2,330	1,660	1,800	...	590	640	35	1,538
Average	2,280	1,795	1,737	...	550	637	36	1,580
Test No. 8								
Ina. Bonnie	2,350	1,760	1,760	540	...	622	35	3,366
Bott. Kell H.	2,440	2,060	1,950	560	...	...	20	3,366
Top Kell H.	2,400	1,900	1,840	600	...	640	12	3,366
Loogootee	2,260	1,680	1,400	600	...	630	35	3,400
Fair Ground	2,250	1,750	1,660	580	...	630	45	3,400
Cadwell	2,280	1,640	1,630	580	...	650	40	3,400
Average	2,330	1,741	1,771	566	...	634	31	3,383
Average for mine run	2,296	1,796	1,719	591.6	550	636	33.2	2,641

* Note:—Temperature reached 2,500 deg. F. and melted tube and couple.
† Note:—This average temperature is low, as tube was burned out, which did not occur in test with mine run.

Feedwater temperature—In tender, 37 deg. F.
At boiler check, inspirator wide open, 170 deg. F.
At boiler check, inspirator cut down to breaking point, 260 deg. F.

with four 1-in. spuds; draft plate 18½ in. from the bottom of the smokebox.

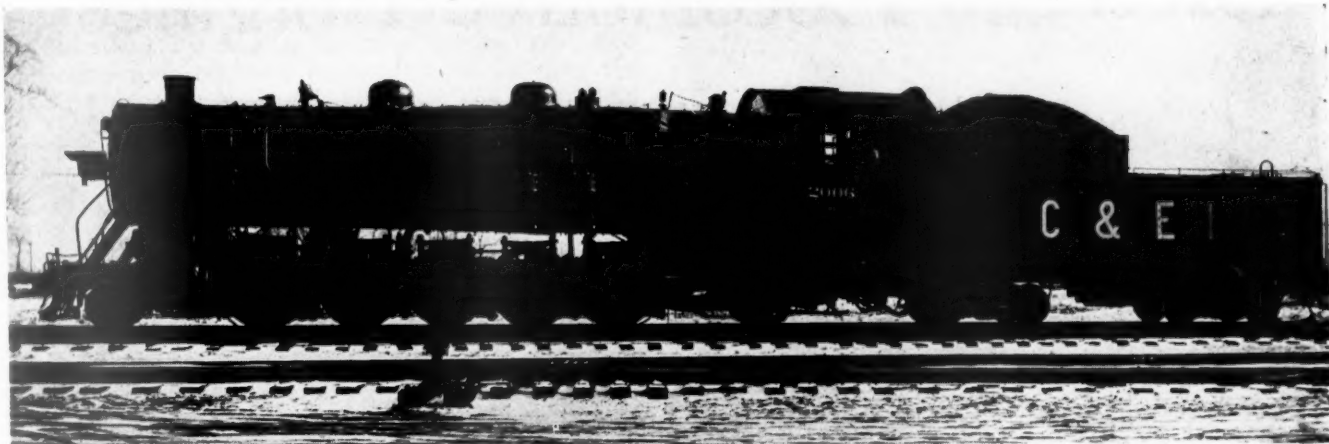
The draft readings taken did not show any appreciable difference between screenings and mine-run coal. There was a slight increase in draft under the arch di-



Comparative average of all draft readings taken on Locomotive 2006

rectly over the fire, indicating possibly a slight increase in resistance of air through the fuel bed with mine-run coal. A considerably higher draft reading was noted in the smokebox on the Santa Fe locomotive than on Mikado locomotives in previous tests. This was partially due to the exhaust nozzle being somewhat small.

breaking up the fuel bed. The operation and functioning of the grates, when dumping fires at the cinder pit, was satisfactory. The small air openings in the grates permitted carrying thin and light fuel beds with an equal and fine distribution of air to all parts of the grate without holes forming in the fuel bed. It is not



Left Side of the C. & E. I. heavy freight locomotive used on test runs

The nozzle diameter was increased to $7\frac{1}{4}$ in. diameter with spuds after the test was completed and the locomotive steamed satisfactorily. A portion of this higher draft was required on account of the greater length of flues, giving higher resistance to gases passing through them.

The low draft readings obtained in the ash pan indicated that the ash pan had ample air openings.

It was somewhat more difficult to build fire with screenings than with mine run, and greater care was re-

probable that the screenings could have been burned successfully in this locomotive on the original finger grates, which also necessitate a smaller nozzle with corresponding loss in power of the locomotive, due to additional back pressure.

From data taken, it will be noted that the average speed on all trips was 30.5 and 33.2 m.p.h. After the above test runs were completed, a trial run was made from Villa Grove to Mitchell yard on fast freight, and a speed of 58 m.p.h. was obtained.

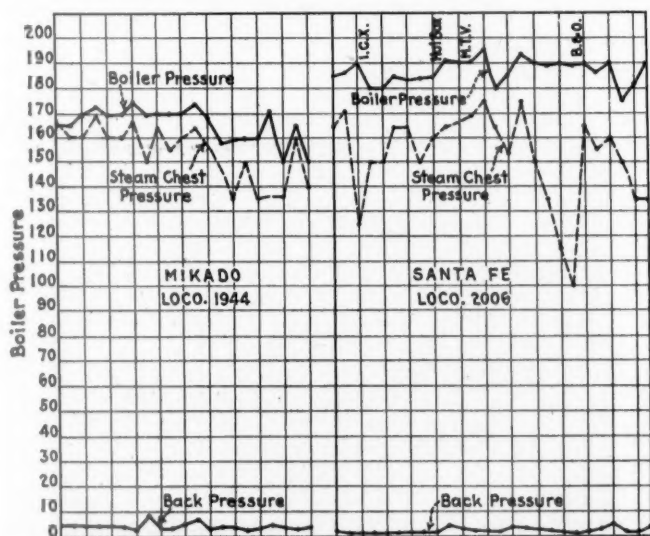
A trial trip was also made from Mitchell Yard to Villa Grove and from Villa Grove to Yard Center. On the trip from Mitchell Yard to Villa Grove on train No. 60, the locomotive did not attain any high speed, but from Villa Grove to Yard Center the locomotive attained a speed of 60 m.p.h. and made the trip in considerably less time than running time between these two points.

At no time during the tests did the locomotive develop any hot bearings and at all times the new rods with the floating bushings ran cool. The locomotive rode smoothly at all speeds; no excessive vibration was noted at high speeds, indicating good counterbalance conditions.

Derivation of Fuel Efficiency Percentages

Based on coal as purchased by weight.—On a g.t.m. basis, the screenings are 110 divided by 113, or 97.3 per cent as efficient as mine run. On an equivalent evaporation basis, screenings are 6.37 divided by 6.94, or 91.8 per cent as efficient as mine run. However, since a portion of the steam produced is used in the stoker and more steam is required by the stoker to feed mine run coal than screenings, the overall efficiency of the two kinds of fuel to produce useful locomotive work should be based on total steam produced, minus steam used by the stoker. Based on 1.9 per cent of the total steam evaporated, as used by the stoker with screenings, and 2.675 per cent with mine run, the number of pounds of useful steam per pound of screenings equals 98.1 per cent times 6.37, equals 6.25 lb.; the number of pounds of useful steam per pound of mine-run equals 97.325 per cent times 6.94, or 6.75 lb.

(Concluded on page 144)



Boiler, valve-chamber and back-pressure readings taken at various times during the test—Similar readings on a Mikado locomotive are shown for purposes of comparison

quired to get the fire in good condition at the beginning of the trip. Aside from this, it was not more difficult to maintain steam pressure with screenings than with mine-run coal.

The Tuyere type rocking grates with small air openings, totaling 38 per cent, in vertical planes only, reduced the loss of fuel through the grates to a minimum. The grates operated easily, removing the necessary amount of ash when rocked en route without excessively

Converting Steel into Locomotive Forgings*

Points to be observed in the mechanical working of the steel and its heat treatment

By Lawford H. Fry

Metallurgical Engineer, Standard Steel Works

IN the transformation from the ingot to large locomotive forgings there are usually two steps. The ingot is rolled or forged to a bloom or billet, and this billet reheated and forged to shape. If tonnage production is important, the ingot is rolled to the billet form and time and fuel saved by transferring the ingot, while still hot, directly from the mold to a soaking pit or furnace and holding it at a high temperature until it goes to the rolls. This process involves the danger that the ingot may not be given time to solidify completely before

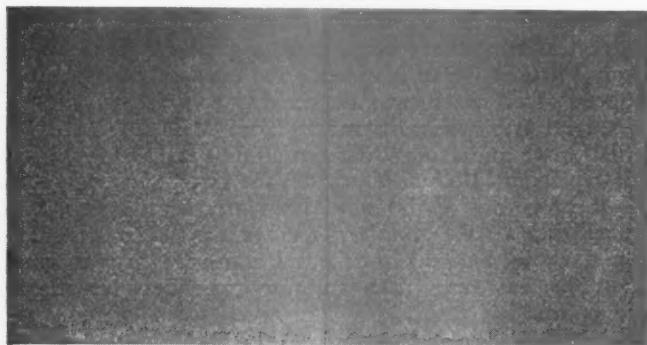


Fig. 1—Portion of sulphur print from a central longitudinal section of a 12-in. square bloom forged under a hydraulic press from an ingot

being rolled. If this happens and the ingot is put through the rolls while the center portion is still semi-liquid, the resulting billet will lack homogeneity and will not be adapted for the production of forgings of the best quality.

By allowing the ingot to cool to atmospheric temperature and then reheating for reduction to billet form, the danger of an uncongealed core is avoided and quality is safeguarded, though at the expense of a slight increase in cost of manufacture.

To safeguard the quality of forgings, attention must be given during the forging process to methods of heating and the temperatures at which the steel is worked. Heating must be gradual, uniform and thorough, particularly in the case of the ingot. At too high a temperature the steel will be injured, a so-called burnt structure resulting.

In order to reduce the grain size and facilitate the grain refinement in the heat treating process it is desirable

able for the final forging work to be done at a temperature not too far above the critical range but too great a forging reduction at a low temperature may cause internal tearing of the steel. The proper forging temperature will depend on the type of steel used, whether plain carbon or alloy, and on the forging to be made. To choose a satisfactory temperature for each type of steel used requires experience and constant vigilance. Here, as in other subdivisions of the subject, detailed instructions as to practice lie outside the scope of the present paper. All that can be attempted is to set up sign posts to show where care and experience are required.

In older specifications it is not unusual to find it required that the forgings shall be made from billets with a cross section not over one quarter that of the ingot and that a reduction of at least forty per cent in cross section shall be made from billet to forging. With this requirement the ingot must have at least 6.5 times the cross section of the forging to be produced. This is unnecessary and may be undesirable. The committee on steel of the A. S. T. M. have made recently an ex-

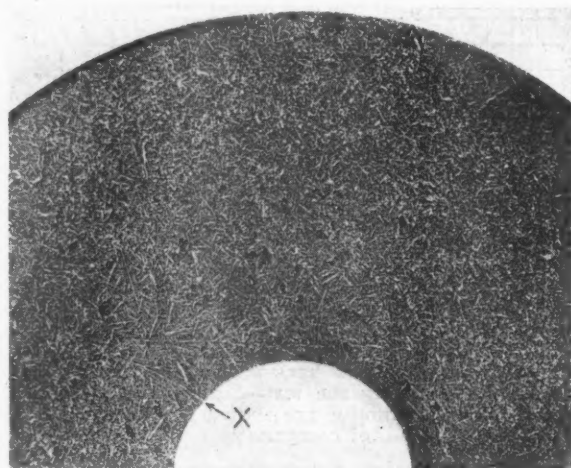


Fig. 2—Photograph of a half section of a locomotive crank pin showing the pattern remaining from the original ingot structure

tended experimental study of the effect of reduction between ingot and forging.

They concluded that in the low ratios of reduction a slight increase in physical properties could be obtained

* From a paper presented before the convention of the American Society for Steel Treating held at Cleveland, Ohio, September 9 to 13, 1929.

by increasing the amount of reduction, but that this increase in physical properties was practically negligible when the ratio of reduction was carried beyond a value of about three to one. The experiments also indicated that it was immaterial whether the reductions were made between ingot and billet or between billet and forging.

Modern specifications are drawn to provide a reduction of at least three to one from ingot to forging. This has the advantage that in the large driving axles and connecting rods required by modern locomotives the forging manufacturer is not forced to use abnormally

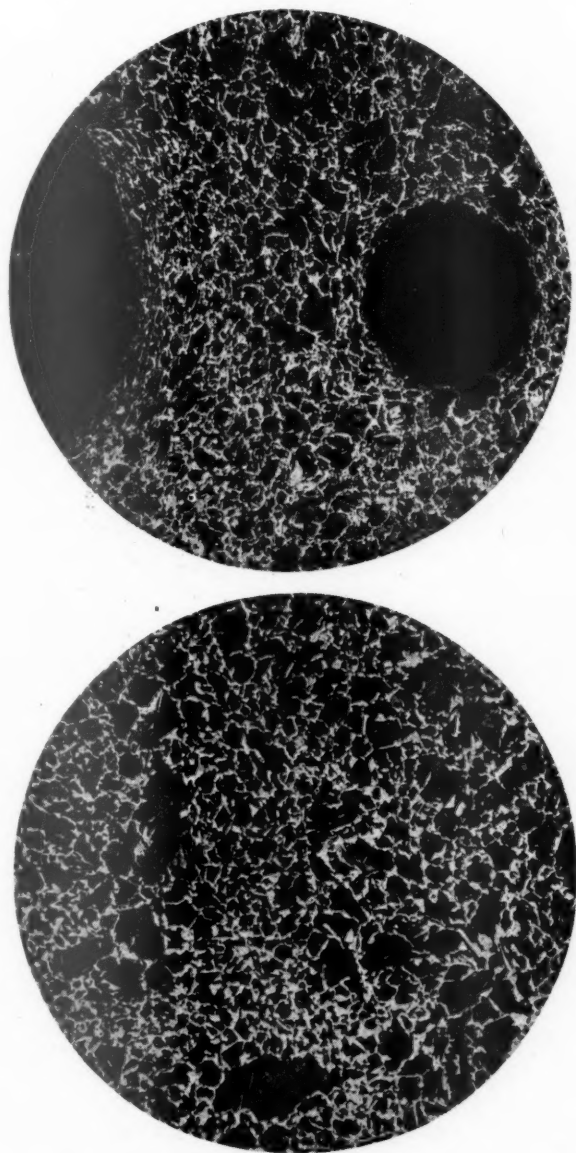


Fig. 3—Photomicrographs of light and dark constituents of etching pattern shown in Fig. 2—The upper view is taken on the light-colored band or Dendrite marked X in Fig. 2—The dark circles are two prick-punch marks made before polishing for the microscope so as to locate the band when polished—The lower view is taken from the dark-etching body structure adjacent to the light-colored band—There is evidently no difference in microstructure—Magnified one hundred times

large ingots in which the secondary segregation may be excessive.

Structure of Forgings

As an example of the structure developed in a forging made from a moderate sized ingot the sulphur print shown in Fig. 1 is offered.

Another illustration of the persistence of the freezing pattern is given in Fig. 2 which shows a deeply-etched cross section of a 10-in. locomotive crank forged from a billet similar to that of Fig. 1. This pin has been quenched and tempered. In considering these patterns brought out by etching or sulphur printing forgings, it is important to understand that etching and sulphur printing both exaggerate greatly small differences in com-

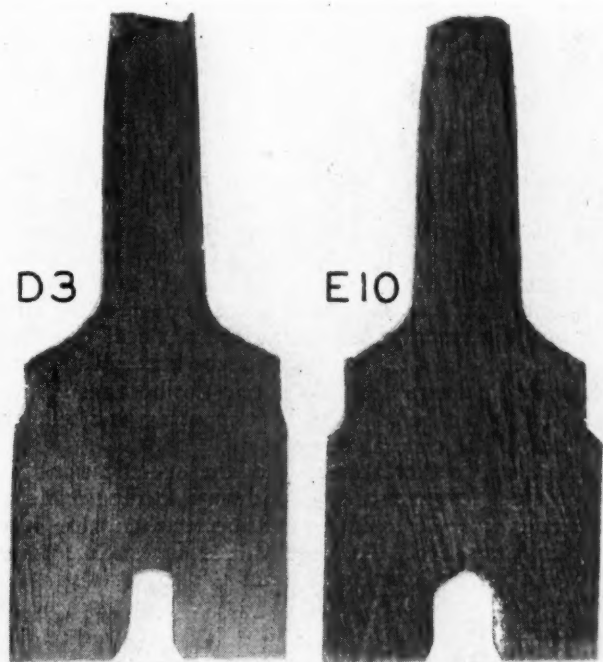


Fig. 4—Photograph of etched longitudinal sections of broken tension specimens from the same forging.—The physical properties of these specimens are as follows:—Specimen D-3, T.S. 88,500; Y.P. 43,500; elongation 25 per cent;—red. area 40.5 per cent—Specimen E-10, T.S. 88,000; Y.P. 47,500; elongation 26 per cent; red. area 45 per cent

position in steel and that the patterns obtained in forgings represent the outline of structures which have disappeared. They are only vestigial remains, ghosts, or as Dr. Hatfield calls them, "pseudomorphs" of the original crystal growths. Fig. 3 shows at A the microstructure of the light colored part of the etching pattern and at B the structure of the adjacent dark background. There is obviously no essential difference in the structure and evidently the carbon content is the same. Any original differences in carbon produced by the minor segregation have equalized during the processes of forging and heat treatment. The boundary between the lightly-etched and the darkly-etched parts is not to be found with the microscope and it is evident that the patterns revealed by etching or by sulphur printing do not necessarily correspond to real structural differences but are spectral remains of the original crystal growths. Further evidence in this direction is offered by Fig. 4, which shows the results of sectioning axially and etching two broken tension test specimens. It appears that there is no relation between the light lines of the etching pattern and the type of fracture.

Types of Steel

Attention so far has been directed mainly to plain carbon steel forgings. For the sake of completeness other types of steel used for locomotive forgings must be considered and the question of heat treatment must be dealt with.

The great majority of locomotive forgings being put

into use in this country today are made from one or five types of steels: namely,

- 1—Plain carbon steel normalized and tempered.
- 2—Plain carbon steel quenched and tempered.
- 3—Carbon-vanadium steel normalized and tempered.
- 4—Chromium-vanadium steel quenched and tempered.
- 5—Chromium-nickel steel quenched and tempered.

The two last named quenched and tempered alloy steels are not very widely used. They are used mainly under special conditions where high stresses are to be carried or a high factor of safety provided. The tendency at present is to get away from quenched and tempered forgings for locomotive service. The steels being most widely used are those which will give good physical properties when normalized and tempered. "Normalizing" denotes heating to above the critical range and allowing to cool in the air. It is in effect an air quench. It has, though to a lesser degree, the effect of a liquid quench in improving the physical properties of the steel, but does not subject the materials to such severe internal stresses. To obtain the best results normalizing should be followed by tempering at a temperature below the critical range.

Based on this treatment modern specifications for carbon steel forgings are being drawn to require tensile properties from 15 to 25 per cent better than were specified ten years ago. Average values for such forgings 10 to 12 in. in diameter from 0.45 to 0.50 per cent carbon steel with 0.50 to 0.75 per cent manganese are approximately:

Tensile strength	88,000 lb. per sq. in.
Yield point	54 per cent of tensile strength
Elongation in 2 in.	25 per cent
Reduction of area	42 per cent

As these are average values for a number of forgings, the minimum specified values should be about five per cent lower.

Normalized and tempered carbon-vanadium steel forgings with carbon 0.35 to 0.45 per cent, manganese 0.75 to 0.90 per cent and vanadium about 0.18 per cent give average values for the tensile properties approximately as follows:

Tensile strength	98,000 lb. per sq. in.
Yield point	60 per cent of tensile strength
Elongation in 2 in.	24 per cent
Reduction of area	45 per cent

This steel owes its strength and high yield ratio to the manganese content, while the vanadium insures satisfactory grain refinement and consequent ductility. When clean and well made and when properly handled in forging this steel gives excellent results in locomotive forgings. The addition of vanadium to a well-made steel will have a beneficial effect on the properties of the steel, but the use of vanadium does not relieve the steel manufacturer of the necessity for using care in the processes of making the steel. Vanadium and other alloys, while improving good steels, cannot remove the fundamental defects of poorly-made steel. In fact since alloy steels are destined to be more highly stressed in the heat treating processes and in service, they require the maximum of care in manufacture to produce good results.

Another normalized and tempered steel that has been coming into prominence recently is a low-carbon two-per-cent nickel with moderately high manganese. This steel has been introduced to secure high ductility. Average values for the tensile properties promise to be approximately:

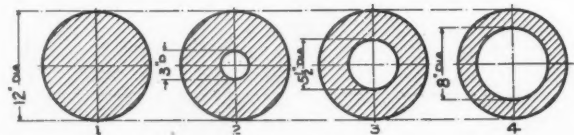
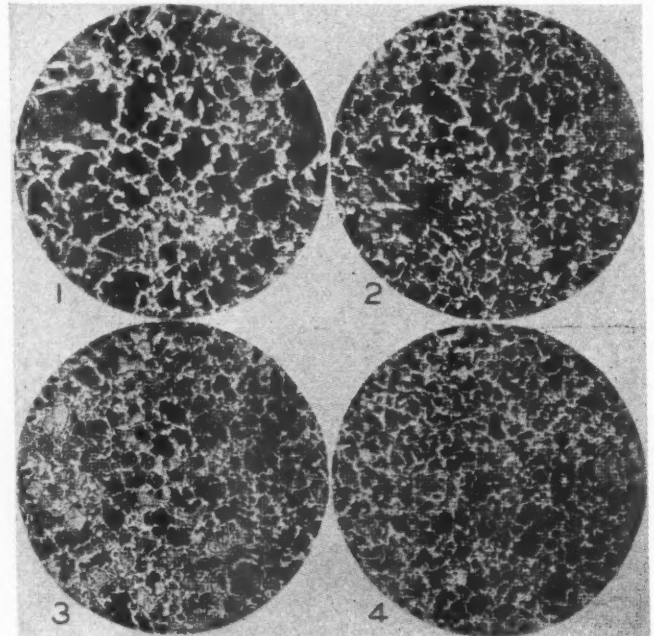
Tensile strength	33,000 lb. per sq. in.
Yield point	65 per cent of tensile strength
Elongation in 2 in.	30 per cent
Reduction of area	62 per cent

Experience so far indicates a successful future for this steel.

Heat Treatment

All of the steels under consideration require some form of heat treatment after having been forged to shape. This is necessary to break up the coarse grain produced by forging and to form the grain structure proper to the composition and the physical properties desired.

Heat treatment therefore consists in heating to selected temperatures and cooling under predetermined conditions. Satisfactory heat treatment requires that,



Ratio, vol. to surface	3 to 1.0	2.25 to 1.0	1.60 to 1.0	1.00 to 1.00
Ten. strength	96,500	97,000	97,500	97,000
Yield point	53,000	56,000	59,000	60,000
Elong.	21.0	23	25.5	25.0
Red. area	34.0	36.0	42.0	40.5
Analysis	C 0.54	Mn 0.58	P 0.034	S 0.040
				Si 0.29

Fig. 5—Photomicrographs showing effect of boring on physical properties and microstructure of normalized steel forging—Magnified 100 times

for quenching or normalizing, the forgings shall be uniformly heated to correctly chosen and accurately measured temperatures, that they shall be held at such temperatures an adequate time to permit the desired metallurgical reaction to take place, and shall then be cooled uniformly in the air for normalizing, or in oil or water for quenching. It should be noted that the physical properties obtained by such treatment depend on the speed with which the forgings cool through the critical range. This speed of cooling will be determined by the size of the piece and by the nature of the medium in which it is cooled. Forgings of the same size will cool slowly in air, more rapidly in oil and most rapidly in water. Consequently when physical properties are compared, those of the oil-quenched will be better than, and those of the water-quenched forgings still better than the properties of the air-cooled forgings. With

forgings of different sizes this will not necessarily be true. A very small piece normalized may cool quicker and therefore give better properties than a large piece quenched in oil. Size as well as cooling medium must be considered in specifying the properties to be obtained. Size also has an effect on the internal stresses set up in cooling. These stresses depend on the temperature gradient; that is, in the difference in temperature between the inside and the outside. This is determined by the rate at which the outside is cooled and the thickness of the section through which the heat must flow. With large sections and rapid cooling the stresses may be so great as to cause rupture. By boring round forgings the section can be very conveniently reduced so as to reduce quenching stresses and to improve physical properties. Boring has the further advantage of reducing the weight with only a slight reduction in strength. In the case of crank pins or axles to be normalized or quenched, a hole having a diameter approximately one-half of the outside diameter is usually good practice. This will reduce the weight by 25 per cent and the strength of the section only 6.25 per cent.

The reduced section permits rapid and uniform penetration of heat, and the increased amount of surface in proportion to the volume of metal makes for accelerated cooling. The influence of boring in improving the effect of heat treatment is illustrated in Fig. 5. Two locomotive driving axles 12 in. in diameter forged from the same heat were selected for this experiment and each was cut in half, producing four forgings each 12 in. in diameter and about 3 ft. long. One was left solid, the others bored respectively with holes 3, 5½ and 8 in. in diameter, making the volume of the four forgings 3.00, 2.25, 1.60 and 1.00 cu. in. per sq. in. of surface. The four pieces were then heated together to a temperature of 1,500 deg. F., held six hours at this temperature and allowed to cool in the air. The tensile properties and the photomicrographs obtained are shown. As the diameter of the bore is increased there is a general improvement in the microstructure and in physical properties, though this is less marked between the 5½-in. and the 8-in. bores than in the other steps. A 5½-in. bore in a 12-in. axle, besides facilitating heat treatment, reduces the weight about 20 per cent and the strength only about 4.4 per cent. It can be seen that there is considerable advantage in boring large forgings even for normalizing. For quenched forgings the advantage is still greater because the reduced section reduced the internal stresses which may easily become excessive with large solid forgings.

Tensile Properties

Four tensile properties are measured usually in acceptance tests for steel forgings; the ultimate tensile strength, the yield point, the elongation in two inches, and the reduction of area. For any given type of steel and for a given heat treatment these four properties must bear a definite relation to each other. Consider first a plain carbon steel normalized and tempered and take the tensile strength as the basic property. If a number of forgings from various melts of steel, treated in different lots, are tested, it will be found that in spite of all reasonable care to obtain uniformity the values for the tensile strength will vary through a range equal to about nine or ten per cent of the mean value. Thus, if a minimum tensile strength of 85,000 lb. per sq. in. is specified, the average value will be about 89,000 lb. per sq. in. with a range between 85,000 and 93,000 lb. per sq. in. The variation will be due in part to variations in composition of the various melts, and in

part to variations in heat treatment. Such variations in tensile strength occur not only between different forgings, but also between different parts of the same forging. In a recent study of the properties of forgings 32 tensile tests were taken from a forging 10½ in. in diameter and about 50 in. long. After normalizing and tempering, test specimens were taken from the standard position, that is one-half way between the center and the outside. Twenty-five of the thirty-two tests gave tensile strength between 87,500 and 88,700 lb. per sq. in., indicating a high degree of uniformity in the forging. The highest and lowest values found for the tensile strength were 86,300 and 91,500 lb. per sq. in., respectively. The yield point stands in close relationship to the tensile strength, but before discussing values it is necessary to decide on how they are to be measured. For the present purpose yield point is taken to be the load per square inch at which, with a uniform test machine speed, there is a definite drop of the beam of the machine. The value found for the yield point for any forging will depend on the speed at which the test machine is run.

With a test machine speed of one-eighth inch per minute the yield point values varied from 50.3 to 54.0 per cent of the tensile strength in tests from a single forging. If a number of forgings are compared the range will be somewhat wider, say from 50 to 55 per cent of the tensile strength.

Elongation and Reduction in Area

The elongation and reduction of area also depend on the tensile strength but by an inverse ratio. The average values for a number of tests are well represented by the equation, tensile strength times elongation equals 2,230,000, while the minimum values are not very different from the curve. It is evidently proper in drawing specifications to take into account this natural tendency for the elongation to increase as the tensile strength goes down. For example if a specification is to be drawn for normalized and tempered carbon steel with a minimum tensile strength of 85,000 lb. per sq. in., it is to be expected, as shown above, that actual tensile strength values will range from 85,000 up to about 93,000 lb. per sq. in. Then a decision should be made as



Fig. 6—Photograph of section of locomotive driving journal, showing thermal cracks produced as a result of poor lubrication

to the minimum elongation which will be accepted with the maximum tensile strength. For example, for forgings not over nine inches in diameter it would be proper to specify that with a tensile strength of 93,000 lb. per sq. in. the elongation in two inches should not be less than 23.0 per cent. Then for lower values of the

tensile strength proportionately higher values of the elongation should be required.

This relation between elongation and tensile strength can be obtained by specifying that the quality factor, or tensile strength multiplied by elongation, shall not be less than 2,130,000. The use of this quality factor to provide a sliding scale for the elongation required is preferable to specifying merely a flat figure for the minimum elongation to be acceptable for all tensile strengths. If, for example, a flat minimum elongation of 23.0 per cent were specified, all forgings with an elongation of 23.0 per cent would be acceptable, whether the value of the tensile strength was 93,000 or only 85,000 lb. per sq. in. For the former the quality factor, tensile strength multiplied by elongation, has the value 2,130,000, while for the latter its value drops to 1,960,000. There is no advantage to the manufacturer in allowing forgings of this grade to have lower quality factor values at the lower tensile strengths, and it is therefore desirable to give the user the protection afforded by specifying that the elongation shall be determined from a sliding scale with a constant quality factor. In the case under consideration this would be done by specifying that the elongation in per cent shall not be less than 2,130,000 divided by the value of the tensile strength and that where the tensile strength is more than 93,000 lb. per sq. in. the elongation shall not be less than 23.0 per cent.

The reduction of area stands also in inverse ratio to the tensile strength, and all that has been said regarding the elongation applies equally to the reduction of area. For the size and type of forgings considered above a proper minimum value for the quality factor, tensile strength multiplied by reduction of area would be 3,400,000.

For quenched and tempered carbon steel forgings the relations between the physical properties are generally the same as those just examined for the normalized and tempered carbon steels; however, the numerical values are different. One difference in measurement must be noted. Instead of taking the yield point by the drop of the beam it is usual for quenched and tempered forgings to use an extensometer and to note the load at which there is a sudden acceleration of the extensometer needle. In the specifications this is called the "elastic limit." In fact it has a value above that of the true proportional limit but below that of the yield point by drop of beam. This method was introduced about 15

years ago, apparently in the belief that it would give a more exact value than the determination of the yield point by drop of beam. Recent study of the question indicates that this belief is not well founded. Particularly with normalized and tempered material the values found for the yield point by the drop of the beam, when compared with values given by the extensometer, are found to be less erratic for a given lot of material, and in addition have the advantage of being more simply and definitely observed and are less dependent on the personal equation or the experience of the observer.

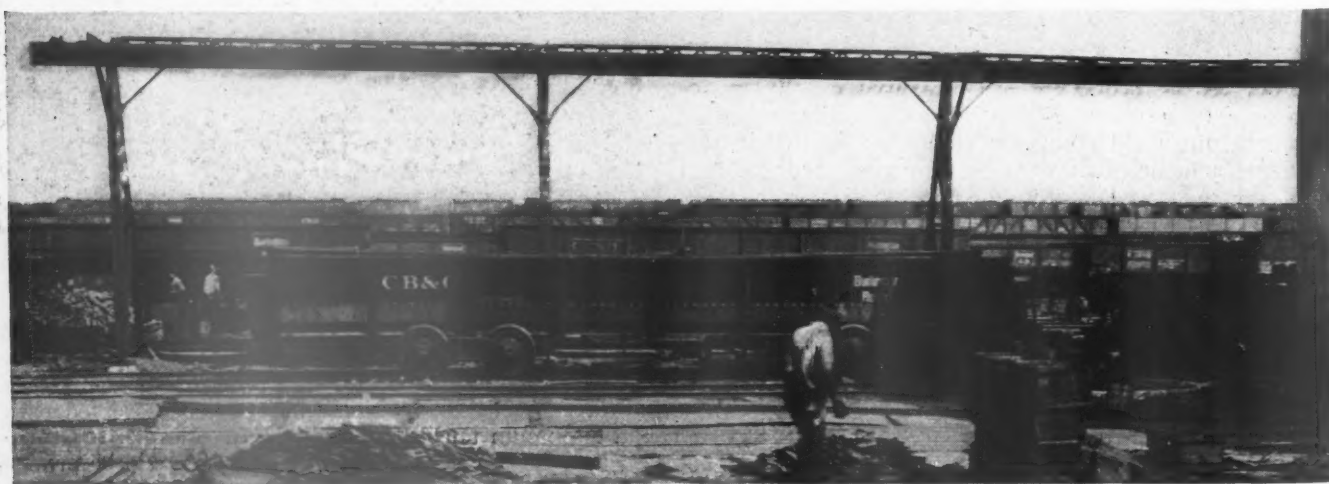
For the alloy steels the conditions as to yield point are the same as for the plain carbon steels, but the inverse ratio between tensile strength and the ductility factors, elongation and reduction of area is not so well marked. This applies both to the normalized and the quenched steels and therefore in all of the alloy-steel specifications it is usual to specify flat figures for elongation and reduction of area instead of using a sliding scale.

Conclusion

In choosing any of the special steels in an attempt to correct a definite type of trouble, as for example axle failures occurring in the journal, all phases of the problem must be considered. If the failed axles show thermal cracks, such as are illustrated in Fig. 6, it is evident that the lubrication has been faulty and it will be good engineering to correct this service condition by mechanical methods, rather than to attempt to find some special steel which will operate successfully under unnecessarily difficult conditions.

At the same time it must be recognized that locomotive forgings are not designed to be wrapped in cotton wool. Rough service and occasional abuse must be encountered. It is to meet such conditions that the special normalized and tempered steels are being developed. At the present time there is some difference of opinion as to whether it is better to use a steel with high tensile strength or with high ductility. As has been pointed out, both types of steel are being tried. Time will bring further information. The problems of producing and handling forgings so as to give constantly better and more reliable results in locomotive service concern both metallurgical and mechanical engineers, and it is only by the fullest cooperation between producers and users that progress can be made.

* * * *



Monorail runway used for handling fabricated car sides direct from the shop and which are loaded on trucks for movement to the erecting track—Steel car shops of the C. B. & Q., Galesburg, Ill.

Examples of Recent Articulated Locomotives of Various Types

General Dimensions, Weights and Proportions

[illegible]

Key to notes: a—Boiler diam., inside; b—Boiler diam., outside; c—Combustion chamber; d—Syphon; e—Feedwater heater; f—superheater; g—Gaines' wall.

* A. R. A. Value except Erie 2-8-8-2. † Weight of tender included.

Aluminum Alloys Serve Railroads*

Increasing use of this material indicates its economic advantages and ready workability

By A. H. Woollen

Engineer, Sales Department, Aluminum Company of America, New Kensington, Pa.

THE first attempt to reduce the weight of railway equipment by means of the application of the strong alloys of aluminum was in Illinois Central suburban service, the first cars being constructed in 1923. The operation of these cars being satisfactory, 215 additional cars were constructed in 1925, consisting of motor cars and trailers with aluminum used for roof sheets, interior finish, doors, conduit, junction boxes, headlights and other small applications. The reduction in weight averages 9,000 lb. per car.

About this time the Pennsylvania went even further and constructed eight suburban cars for the electric suburban service outside of Philadelphia with all-aluminum superstructures; that is, posts, carlines, outside and inside sheets, bulkheads, doors, and, in fact, everything above the underframe, with the exception of a belt rail which could not be manufactured in aluminum at the time.

There followed shortly thereafter the construction of

cents to 45 cents a pound, or, on a square-foot basis, 9 to 15 cents, as compared with 3 to 6 cents for steel. Therefore, it is necessary to justify this increased cost which amounts to from \$800 in a small city-type car to \$4,000 or \$5,000 in a large railroad car. It has been our experience that this extra cost can be reduced to a unit figure of 20 cents additional cost for each pound of weight saved.

Aluminum Car Construction Offers No Serious Difficulties

The construction of aluminum cars in car builders' plants does not offer any difficulties that cannot be overcome in a modern shop. Punching, shearing, machining, riveting are all performed with the usual tools available for steel. Bending cold must be watched and the particular qualities of the various grades and tempers of aluminum alloys known, but as soon as the shopmen accumulate experience, this problem offers no objection.



Suburban passenger coach having all-aluminum sheets above the underframe

120 Chicago & North Western suburban cars having all aluminum sheets above the underframe. Both the Illinois Central and the Chicago & North Western have since put in service additional cars and have extended the use of aluminum somewhat over the original applications. One of the larger roads, after a thorough study of the cars in service, is now planning an even greater application than has yet been attempted, in which aluminum underframes and truck frames will be used. Many other roads have adopted aluminum for sheets and shapes in gas-electric car design on account of the desirability of weight reduction due to power-plant limitations.

At the present time, aluminum alloys cost from 28

Hot bending or forming is the only special feature of aluminum alloys to require particular attention by shop forces, as the technique varies considerably from that of steel. Temperature control is essential, and heating facilities must be provided, differing from those in common use for steel. The strong alloys of aluminum will begin to anneal at 450 to 500 deg. F., and if heated beyond that point must be reheat-treated to regain their original strength. Heat-treatment requires a furnace which can be held at from 930 to 960 deg. F., from which the material is quenched to room temperature. However, the necessary information is available to every shop, both from printed matter and by personal instruction, so that in a short time the shopmen can manipulate the aluminum alloys in an efficient and economical manner.

* Abstract of a paper presented at the January meeting of the Western Railway Club, Chicago.

The welding of aluminum can be accomplished by the usual oxy-acetylene torch, and development work is in progress with electric-welding apparatus which promises some excellent results.

Cost of Maintenance Probably Reduced

The maintenance of the aluminum car should not be any higher than that of the car constructed of materials now standard, and there is considerable indication that we may expect a lower maintenance cost for there will be no tendency for the paint to peel off due to corrosion such as is common in a steel car. If the original paint job is properly done, it would appear that a periodical freshening of the varnish coat should keep the car in good shape and practically avoid a complete burn-off, thus saving \$75 to \$100 per car per year from this source alone. The replacement of aluminum parts damaged in accidents will cost more than steel, but the damaged parts can be sold for scrap at from 40 to 60 per cent of their first cost.

Cars built of aluminum show no corrosion after two to five years of severe service which leads to the assumption that, as far as corrosion is concerned, the aluminum car will last practically indefinitely.

The shop equipment necessary for the proper maintenance of aluminum cars will not differ from that now used, with possibly two exceptions—a heating furnace and a portable pyrometer. An electric furnace costing \$4,000 or \$5,000 is preferred, but this would not be necessary until a large amount of regular repair work became necessary, as the ordinary blacksmith forge could take care of most of the jobs of straightening or bending structural shapes required for repair work. It would be necessary, however, to purchase, at an early date, a portable indicating pyrometer which would cost approximately \$50. This instrument would permit the



Fitting hot-pressed aluminum shapes in a Pennsylvania coach

handling of aluminum with greater ease in ordinary equipment and prevent damage by overheating.

Other Uses of Aluminum Alloys

There are numerous other railroad applications of aluminum alloys. Probably the most important of these at the present time is the aluminum tank car. Between 75 and 100 of these cars will be in service on American railroads within the next six months transporting glacial acetic acid, formaldehyde, turpentine and other

commodities which may be transported in aluminum cars without damage to car or commodity and thus save the additional cost of lining a steel car. In every instance the aluminum tank car is justified on the basis of first cost; and the savings which it makes for its user are available from the start.

Another use for aluminum has been developed and is still in the experimental stage. I refer to the aluminum connecting rods for steam and electric locomotives and aluminum valve gear parts for steam locomotives. We have had aluminum main and side rods on the Al-



Aluminum conduit, junction boxes, etc., installed underneath an Illinois Central multiple-unit car

ton & Southern switching locomotives for several years and the reduction in weight of these reciprocating parts effects material savings in maintenance of both locomotives and permanent way structures. With such an important part of the locomotive as the connecting rods we want to be sure that a design is developed which will take advantage of the physical properties of the strong aluminum alloys in such a way as to provide equal, if not greater, safety with the aluminum rods as with the present type of construction. We have demonstrated, to our own satisfaction at least, that the rods in switching locomotives are satisfactory, safe and economical, but before going on to the main line, we felt it essential to conduct laboratory tests on the largest type of freight locomotives which would travel at sufficient speed to introduce substantial factors of centrifugal force. We are now making a set of rods for a heavy Mikado type locomotive and intend to study its performance in a large railroad testing plant. This locomotive will be operated under normal and maximum service conditions and, by means of recording instruments applied directly on the rods, we will have an exact knowledge of the conditions existing in the vital parts of the rods. The locomotive will then be taken out on the road and a service test made. It is hoped that by the June convention of the American Railway Association, Mechanical Division, our tests will be completed and we will be in a position to say to you gentlemen that aluminum side rods, main rods and valve motion parts may be safely and economically applied to any standard steam locomotive.

Aluminum Dining Car Furniture

One of the most useful applications of aluminum products on the railroads has been the furniture, developed originally for the Pennsylvania. Aluminum dining-car chairs have found wide use and are manufactured in the Buffalo, N. Y., plant to suit the requirements of the railroads. Alcraft aluminum furniture,

as it is called, is available in almost any finish and upholstery to meet the desires of the railroads and car builders and shows immediate returns in low maintenance cost.

Additional miscellaneous uses of aluminum and its alloys in the transportation field are: Transmission lines of aluminum cable, steel reinforced; Albron powder as a base for aluminum paint for signals, bridges, shops, roundhouses, etc.; architectural material, including corrugated sheet factory sash, casements, etc. Enginehouse smoke jacks have shown that the corrosion from the stack gases will not proceed as rapidly when made of aluminum as of other materials. Aluminum conduit is finding increased use for protecting wiring on locomotives, cars, in shops and enginehouses, and for similar reasons.

Discussion

At the conclusion of the paper, an open discussion was invited and H. A. Brennaman, assistant works manager of the Pennsylvania at Altoona, Pa., commented briefly on the fabrication of aluminum alloy parts used in constructing eight suburban cars at the Altoona shops. Mr. Brennaman said that anticipated difficulties with the fabrication of these parts did not develop and that, with the proper pyrometer-controlled furnace equipment and reasonable care, no more difficulty was experienced in handling aluminum alloy parts than mild steel parts. He said that existing die equipment could be used equally well for both materials and that tests of aluminum alloy parts, pressed either hot or cold, showed no defects. Mr. Brennaman's remarks were corroborated by J. P. L. Sheets, general car foreman at the Wilmington, Del., shops of the Pennsylvania.

Aluminum Alloy Connecting Rods Give Satisfactory Performance

T. H. Pindell, general manager of the Alton & Southern, described the performance of aluminum alloy connecting rods and valve-motion parts on a switching locomotive which has been in service since 1926, giving entirely satisfactory performance with noticeably reduced maintenance cost. He also said that maintenance-of-way expense was reduced owing to the small amount of rail hammer with light rods and counterweights. J. W. Coulter, master mechanic of the Alton & Southern, estimated the weight reduction as a result of installing the aluminum alloy rods at a net saving of 42 per cent of the weight of equivalent steel parts and a saving in rod maintenance in the ratio of 3 to 5, as compared with equivalent steel rods. He explained this as being due to reduced weight of reciprocating parts, less unbalanced weight in the driving-wheel counterbalances, and consequently a smoother operating locomotive with less rod-bushing and main-bearing wear. In response to a question, Mr. Coulter said that no loosening of bushings in the aluminum alloy rods was noticeable more than in steel rods.

Aluminum Roof Sheets on Passenger Cars Reduce Corrosion

W. T. Kelly, representing the engineering department of the Illinois Central, outlined the performance of 260 multiple-unit cars, constructed with aluminum roof sheets, interior trim, conduit, etc. He said that no trouble has been experienced with these cars and that the use of the aluminum roof sheets of the same gage as steel sheets was particularly helpful in overcoming corrosion difficulties, formerly encountered with steel sheets, which required renewal sometimes as often as

once in four years. In response to a question, Mr. Kelly said that in his experience the greater expansion of aluminum alloys as compared with steel, when the two materials are riveted together, is taken care of by a slight buckling of the aluminum. In no case, however, has this expansion been sufficient to shear rivets or give other serious difficulty.

Increasing Field in Railroad Equipment for Special Alloy Steels

Upon an invitation from the chairman, G. Van Dyke, manager of the special steel department of Joseph T. Ryerson & Son, Inc., said that an entirely new era of metal construction and application has been developed during the last few years, as indicated by the fact that a metal costing in the neighborhood of 40 cents a pound is being suggested as a substitute for other material which can be purchased for approximately 5 cents a pound. He said that corrosion-resisting alloys, heat-resisting alloys, alloys with high physical properties, acid-resisting alloys and many other metals have been developed, and it is gratifying to note that the makers of all these materials are approaching their sales problems from the standpoint of real service and economy to their customers. Mr. Van Dyke mentioned the use of Allegheny metal in dining-car kitchens where its non-rusting and tarnish-resisting qualities, and low upkeep cost, make its application particularly advantageous. In connection with heat-treatment, he said that the treatment of aluminum alloys within temperature limits of 930 and 960 deg. F., is an indication that the use of modern metals is bringing with it an accuracy and exactness of handling which has taken the place of former guesswork methods. On behalf of the makers of all new metals, Mr. Van Dyke appealed to the railroad men, when forming an opinion regarding the workability of any material, to determine first whether they have developed the right technique for handling, and, if not, whether it may be entirely feasible to install the necessary methods and equipment, thus enabling the railroads to use the material to their profit.

Tests of Screenings

on the C. & E. I.

(Continued from page 135)

Therefore, overall efficiency of screenings on the evaporation basis, deducting steam used by the stoker, is 6.25 divided by 6.75, or 92.6 per cent.

Based on coal, if purchased on B.t.u. basis.—On a B.t.u. basis, one pound of screenings is equal to 11,646 divided by 11,940, or .975 lb. of mine run. On a g.t.m. basis, based on relative B.t.u. values, the screenings are 110 times 11,940 divided by 113 times 11,646 or 99.8 per cent as efficient as mine run. On an evaporation basis, if 11,646 B.t.u. in screenings will evaporate 6.37 lb. of water, 11,940 B.t.u. of screenings will evaporate 11,940 times 6.37 divided by 11,646, or 6.52 lb. of water, which is the equivalent evaporation of screenings on a B.t.u. basis. Therefore, on a B.t.u. basis, screenings are 6.52 divided by 6.94, or 93.9 per cent as efficient as mine run. However, taking into consideration steam used in the stoker and basing the efficiency on useful steam produced, screenings are 98.1 times 6.52 divided by 97.325 times 6.94, or 94.7 per cent as efficient as mine run.

EDITORIALS

Why the Balcony?

ONE of the important features in the construction of the Canadian National locomotive shops at Point St. Charles is only briefly referred to in an article describing these shops which appears on another page in this issue. All of the work is performed on the ground floor of the building. No repair or manufacturing departments are located on balconies or second floors. It is needless to point out that the elimination of balconies has simplified the problem of handling material between departments, especially to and from the erecting shop, and has also enabled the designers to construct a building in which the maximum of daylight is afforded for all departments.

Considerable study was given by the designers and the railroad management during the planning and preliminary work on these shops to the problem of securing this particular feature. The result was the designing of a shop building with 56-ft. head room in the erecting shop and 35-ft. clearance in the side bays with no balconies or flooring to obstruct the diffusion of light through the windows. All of the light machine departments are located on the same floor as the erecting shop, and are easy of access to all points where stripping and assembly work is being carried on.

Undoubtedly advocates of the balcony design of locomotive back shop will want to know the difference between handling material vertically or horizontally, and will also point out the fact that the Point St. Charles shop covers considerable floor area. Ground limits frequently bear an important influence on the design of a new shop. However, a gross floor area of 277,100 sq. ft. compares favorably with a number of shops which have been recently built with balconies and designed to turn out approximately the same number of class repairs.

Handling material to balconies which open directly to the erecting shop, does not require much time. But it does tend to tie up crane service. Handling material to balconies by truck and elevator does take more time than trucking across the floor to departments that are located on the same floor as the erecting shop. Any one who has been in the Point St. Charles shops will have to admit that the single-floor layout has the advantage of affording better lighting conditions, and safer and more efficient handling of material, and has made it easier to maintain a clean shop.

What About the Third Trick?

MANY manufacturers of special equipment installed on modern locomotives maintain well-organized service departments, the duties of which are to assist road foremen in developing correct methods of handling this equipment in connection with the operation of the locomotive and to assist the engine-terminal forces in properly caring for and maintaining it. In the latter case they are frequently called upon by busy enginehouse foremen to teach them correctly to interpret symptoms which indicate that all is not well with a

device, particularly during the early months of experience with it. They are also of great assistance in suggesting methods of dealing with unusual conditions affecting the successful operation of such special equipment which may arise at any time even after the terminal forces have become thoroughly accustomed to its routine handling.

This service is a big factor in the success with which the operating results expected from special equipment are actually obtained. In rendering it the representatives of the service departments of the manufacturers do not content themselves with calls upon superintendents of motive power and master mechanics, but visit the enginehouses and offer direct assistance in the form of suggestions and instruction to the men who must deal first hand with the operating and maintenance problems. This phase of their work is much appreciated not only by the men in the enginehouse, but by the department executives as well.

In carrying out this part of their duties the service men devote most of their attention to the first- and second-trick supervisors. Unless some special condition develops leading to a visit during the third trick by appointment, the third-trick supervisors seldom see a specialty service man. Would not systematic calls at the enginehouse during the third trick, even though less frequent than those made during daylight hours, be worth some sacrifice in the regularity of the hours of the service man? Certainly the third-trick supervisors would be greatly appreciative of such attention and would profit by the first-hand suggestions and information thus made available. So also would the department executives.

Stabilized Forces and Morale

THE stabilization of mechanical department forces and keeping up the morale of the organization present two of the most important problems that face mechanical officers today. In this case the two problems are so intimately related that the solution of one is to a great extent dependent on the solution of the other. The spectre of the shut-down or the lay-off has been before railroad men as far back as most of them can remember and there is no accounting system that will enable a railroad company to determine the actual loss in production which the lowered morale of an organization is responsible for.

It has long been the practice on most roads to hire men when business is increasing, then lay them off when a reduction of traffic on the road makes retrenchment necessary. The railroad company suffers a loss when men who have become experienced are lost to the service and it becomes necessary to hire and train new men.

If it were possible to reduce the force without laying off men, a retrenchment policy could be carried out with practically no detrimental effect on the morale of the organization. A mechanical officer on a certain road made a study of labor turnover and found that under certain conditions it averaged between two and three per cent each month. By the simple expedient of not filling vacancies as they occurred the force, over an entire

division, was reduced by 300 men out of a total of 5,500 in about two months' time.

There is so much sound logic in this method that it would seem worth while to study the possibility of forecasting possible retrenchment programs far enough in advance to send out notices to supervisors to cease filling vacancies rather than to lower the morale of the entire organization by being brought face to face unexpectedly with the necessity of shutting down the shop or laying off men.

Handling Renovated Packing

THE editorial on renovating journal packing which appeared in the February issue caused several readers to write us for further information as to how the figures given in the editorial were arrived at, and what methods were used in the handling of renovated packing by the railroads referred to. One of these roads gives particular attention to the following items pertaining to car journal lubrication: Repacking journal boxes; lubrication cost per box packed; used packing returned to the renovating plant; amount of free oil used in freight and passenger service, and number of hot boxes in freight and passenger service. Increases or decreases, as the case may be, from the preceding month's figure are analyzed and discussed at monthly car-department staff meetings. In addition, actual performance figures are compared with a quota figure which has been set up as a mark to shoot at.

The number of repacked journal boxes is, of course, controlled to a considerable extent by the number of working days during the month and by the number of car men employed in such work. The cost of lubrication is affected by the relative quantities of renovated and of new oil and waste which are used. The lubrication cost per box packed is obtained by adding the labor and material expenditures, with proper allowance for other expenses, and dividing the total by the number of journal boxes packed.

An important item in ascertaining the efficient operation of a renovating plant and the utilization of its product is the comparison of the amount of prepared packing shipped to various points along the line and the amount of packing returned from each of these points. The amount of packing returned should be as large as the amount of prepared packing shipped. In case more prepared packing is being shipped than the amount of used packing which is being returned, there is a possibility that some of the used packing is being used for purposes other than that for which it is intended, such as lighting fires, etc. New oil and waste must be used at the renovating plant in preparing packing if an insufficient supply of used packing is returned from outlying points. This increases the cost of lubrication.

A number of railroads are now following the practice of adding a pint of free car oil to the journal boxes of each car as it passes over the hump in the classification yard. In all probability some of this oil is added to boxes where it is not needed. Nevertheless, the practice, from the standpoint of hot-box prevention, appears to be justified, especially in main-tracker service.

The editorial in the February issue was written to show what two railroads had accomplished toward satisfactory car journal lubrication by the use of renovated packing. The installation and operation of a renovating plant either by the railroad or by a contracting company involves a considerable outlay of money. It is, there-

fore, necessary to have some system of cost accounting in order to determine whether a profit is being realized on the transaction. The ultimate aim, after all, is to keep the number of hot boxes down to a minimum and thereby reduce the number of delays to freight and passenger trains. Naturally other items pertaining to the successful operation of a renovating plant than those given in the preceding paragraphs must be considered. However, a careful study of the preceding five items will show that the human element is the most important factor. Proper instruction, close supervision with special attention to details and the furnishing of good lubricating materials has been demonstrated to be the only satisfactory solution of the hot-box problem.

Railroad Color Experts

RAILROAD men, as a rule, are not color-blind, but the statement can hardly be questioned that few of them are color experts. The psychological effect of color is so striking that, unconsciously, we are under its spell much of the time. Because of it, we find some homes, and likewise some passenger cars, more cheerful and inviting than others. These are the homes and the cars which we like to visit best and in which we like to stay longest.

True, the style and arrangement of furniture mean a lot, but color is the real secret of beautiful rooms. It is the first means of attracting the eye and it influences everything else. A person without accurate knowledge of the proper combinations of colors and shades of color may make a harmonious selection for a decorative scheme, but if so, this happy result will be secured only by chance.

When a railroad is in the market for a substantial number of passenger cars, with an expenditure possibly running into millions of dollars, is it not then a logical thing to call in a competent authority on the question of color schemes and be guided by expert opinion in the important matter of making a harmonious selection which will prove appealing to the traveling public? The interior decorator's ability lies in the scientific and artistic selection of subtle, interesting colors. To him, any blue is not just "blue." It is a "warm" blue or a "cold" blue and he knows when to blend the warm shade or the cool shade to achieve a certain effect. He understands the effect produced by different color combinations on the subconscious mind.

Warm colors are usually considered to be those with a predominance of red. Cool colors are those in which blue predominates. For example, a red wall gives the impression of being warmer than a blue wall because red is the color of sunlight and fire. The reverse is true in the case of cool colors, the colors of shadows and of evening. Any color, however, may be "cool" or "warm." Entirely aside from the impression which a color creates, it cannot be questioned that, under some conditions, colors actually influence the thermometer.

A railroad should, therefore, take into consideration the territory through which it is running during the major portion of the year, and the climate. Trains operated in the northern part of the country are subject during most of the year to cool or cold weather. Therefore, the colors should be warm and cheerful. A "cold" blue or a "cold" gray should never be used under these circumstances. A train operating from Chicago to Los Angeles, for example, via the southern

route, should be decorated in a color scheme that is cool because, during the greater part of the year, the major portion of the run is in a warm climate. When neither extreme is desirable, there are shades of color and combinations to be had which, to the artist's mind, are satisfactory for an all year-round color scheme, suitable for passenger cars operating through both cold and warm climates.

A man may be an expert in mechanics and a master in the design of locomotives or passenger cars, but unless he is also expert in the art of colors, he can hardly be expected to select the color scheme for modern passenger equipment with satisfactory results, except by chance.

Railroads leave the design of locomotives and machinery in experienced hands and it is just as logical that the choice of colors and their various combinations as used in passenger-car interior decoration should be left in the hands of those with equally highly specialized experience.

Too Much Maintenance

DURING the course of a conversation between three or four mechanical department men recently the opinion was expressed by one that on some roads the practice of shopping locomotives on a mileage basis for general repairs results in over-maintenance in many individual cases; in other words, many locomotives are arbitrarily shopped on a mileage basis when actually they are in condition to render satisfactory service on the road for several thousand more miles.

During the past five or six years the trend in locomotive maintenance has been definitely in the direction of higher and higher standards of maintenance in order that power might be in condition to meet the exacting demands of modern high-speed, heavy-tonnage, long-run traffic.

In view of this fact it would seem almost ridiculous to suggest that locomotives could be maintained any too well. On the other hand it might be well worth while to look into this question of "over-maintenance" in order to find out whether or not the modern locomotive is not capable of rendering somewhat greater service than has yet been demanded of it.

On one road a certain heavy freight locomotive was found to be able to haul over 70 per cent more tonnage over a certain territory than the transportation department had ever before thought possible. It was another case of not knowing what could be done until it was tried out. Is it not possible that, with the higher standard of maintenance that has been set up in recent years, a revision of the assigned mileage figures might not be made?

The real value of any investigation along the lines suggested above might be the development of information to the effect that in many cases the assigned mileage on certain classes of locomotives could be materially increased were it not for the fact that minor mechanical defects or the failure of parts caused the shopping of the locomotive prematurely when its general mechanical condition was such that it might otherwise run several thousand more miles in road service.

The modern sales idea of setting up quotas as a mark to aim at has developed two things: First, that it is sometimes easier to accomplish things than was previously thought possible, and, second, that it is often a very small obstacle that stands in the way of greater

accomplishment. The assigned mileage of locomotives between shoppings for general repairs is in reality but a mark to shoot at. Probably in many cases the mileage figures have been determined by setting them arbitrarily at a figure that is not too difficult to meet. In looking at the mileage assignments on some roads it will be seen that the mileage between tube renewals is about twice that of the mileage of tires or between general overhauls of machinery. It would hardly be reasonable to expect a set of tires to run as long as a set of tubes but is it unreasonable to expect that, except for tires, a locomotive might be kept in such running condition that the mileage between shoppings for machinery overhauling could be increased to a point where it approached flue mileage?

This question, "Are locomotives being over-maintained?", is a challenge to the modern mechanical department policy of setting up high maintenance standards. The standards are justified but are the railroads getting all the service that they have a right to expect?

NEW BOOKS

POPULAR RESEARCH NARRATIVES, VOLUME III. *Collected by the Engineering Foundation, 29 West Thirty-Ninth street, New York. 174 pages, 5 in. by 7½ in. Published by Waverly Press, Inc., Baltimore, Md.*

Fifty brief stories of research, invention or discovery, directly from the "men who did it," are contained in this third volume of Popular Research Narratives, which present to the reader in authentic form concrete examples of the methods, vicissitudes and triumphs of scientific research. These narratives are collected from researchers and inventors and are put into the layman's language very briefly, in order that the reader may know a little more about the ways in which scientists and engineers are serving their fellow men. A few of the subjects listed in the table of narratives are as follows: Distances of the Stars; Contour Mapping from the Air; Pictures by Phone; Brass—An Old Alloy Rediscovered; Ductile Arc Welds; Grinding—A Precision Method for Quantity Production; The Aircraft Radio Beacon; Ventilating Vehicular Tunnels, and Aluminum Plating—A New Means for Protecting iron.

RECORD AND INDEX. *Published by the American Society of Mechanical Engineers, 29 West Thirty-Ninth street, New York. 432 pages, 6 in. by 9 in. Black board binding.*

As a historical record of the activities of the American Society of Mechanical Engineers during the year 1928, Record and Index, combines all of the reference material likely to be of permanent worth and, as an index, is a means of locating the technical information contained in all of the society's publications. The index combines in a more complete form than heretofore attempted, the separate indexes of Transactions and Mechanical Engineering, as well as references to the reports and other technical publications of the society which have appeared during the year. The scope of the Transactions index has been broadened with the intention of making available material which is frequently a part of papers or discussions, but not so closely related to the subject of the paper indexed as to be located by the usual references to that paper. This Record and Index, which is the second published by the Society, also contains information about the organization and operation of the society.

THE READER'S PAGE

Two Corrections and a Comment on Grates

GALVESTON, TEXAS.

TO THE EDITOR:

Here are some more complaints and comments which I hope will, at least, indicate that one of your readers peruses the *Railway Mechanical Engineer* from cover to cover.

First, the locomotive depicted at the bottom of page 64 in the February number does not represent the "Rocket." It appears to be a model of the Stockton and Darlington Railway engine "Locomotion," No. 1 which was in use for some years before the "Rocket" was thought of.

On page 112 of the same issue, it is intimated that the Canadian Pacific locomotives of the 5900 series, apparently with a tractive force of 78,000 lb., are at present the most powerful in the British Empire. I would remind you that, on page 733 of your 1924 volume, you described the Canadian National locomotives of Class T-2, which have a maximum tractive force of 80,200 lb. without booster.

Turning back to pages 81 and 87 of the February number, the following quotation may be of interest. It is translated from Prof. Lomonossoff's book on "Lokomotivversuche in Russland," copyrighted in Germany in 1926. The paragraph has to do with the burning of anthracite coal in some of the 2-10-0 type locomotives built in America for Russia during the war.

"Grates, partly movable and partly fixed, with conical openings having an effective area of seven per cent, were designed by the experimental bureau in 1916 for the 2-10-0 type locomotives of series E, on the basis of Prof. Kirsch's laboratory experiments (of 1912). With this arrangement, the most violent combustion and the highest temperature were not found on the grate, but considerably above it, and, in addition, the velocity of air in the conical holes was so great that these could not be stopped up by clinker. These grates worked with complete satisfaction on the 2-10-0 type locomotives, with sufficiently contracted exhaust-nozzles."

The round hole grate may be eminently suitable for burning coal which breaks up readily into small particles, but its value for burning other kinds of coal is problematical.

WM. T. HOECKER

Comment on Coach Seats

CHICAGO, ILL.

TO THE EDITOR:

I was much struck with the arguments presented in your editorial, entitled "Coach Seating Facilities," in the February *Railway Mechanical Engineer*. There is no doubt that, in the past, too much emphasis has been placed on crowding as many seats as possible into a coach. It appears that the designer had this feature principally in mind and, by reading descriptions of passenger coaches built some years ago, you will find that the seating capacity is much emphasized. For this reason, a number of railroads have passenger cars in service with undesirable arrangements of seats in relation

to windows; some seats being so placed that the passenger faces, at all times, a panel, obstructing his view. The natural consequence of such an arrangement has been that cars so designed have become very unpopular, and when passengers have any choice, it will be found that these seats are not occupied unless the cars are so crowded that passengers must occupy them or stand up.

I also agree with you fully that more thought and effort should be given to the design of seats for coaches. The standard reversible seats and reclining seats used in coaches and chair cars are far from representative of the comfort and convenience which passengers rightfully demand today. The bucket type of seat, which several railroads have adopted, represents a great step in the right direction, but I believe that still more could be done along this line, and, particularly, by allowing more space between seats. Particularly on long-run passenger trains, at least 90 per cent of the time, the equipment has seating capacity several times that of the number of passengers hauled.

The reaction of the loss in passenger revenues and passenger revenues on the minds of some men who are responsible for this service seems to be one of despair. They have developed a feeling that the downward trend in the passenger revenues cannot be stopped and that it is a waste of money to provide equipment along modern lines and with that comfort and convenience which the general public has become accustomed to in personally-owned motor cars or motor busses. This attitude is wrong. Both in passenger-car and dining-car service, much can be done which would help to attract the public, which, to some extent, has now been driven away from railroads due to their attitude of indifference and their conservatism in adopting facilities which would make the passenger-car equipment more attractive and comfortable.

MECHANICAL ENGINEER.

Main-Tracker Inspection

TO THE EDITOR:

The article, "Inspecting the Main-Tracker for Long Runs," which appeared in the January issue of the *Railway Mechanical Engineer*, seems to have been read with considerable interest, especially by those readers who have taken violent exceptions to some portions of it. Needless to say, all improved methods or radical changes in railroad work meet with more or less opposition and the changes set forth in this article have so altered the old method of car inspection that adverse criticism was to be expected but should be heartily welcomed.

In the February issue of the *Railway Mechanical Engineer*, mention is made in an editorial of exceptions being taken to two air-brake inspectors and two air-brake repair men being able to handle sixteen 100-car trains. They certainly do not, but they do handle the trains despatched during their tour of duty (eight hours) and by referring to the article itself, particularly to paragraph two, page five of the January issue of the *Railway Mechanical Engineer*, a resumé of the force necessary to handle sixteen 100-car trains over a period of 24 hours is shown. This merely designates the force

required to handle trains over an eight-hour shift and must be tripled to handle the 16 trains in question.

Can any good reason be advanced by the operating department officers for bunching trains either into or out of a terminal? Do train despatchers call freight trains from yards just ahead of scheduled passenger trains? Then why should several freight trains be called at or about the same time? On many railroads freight-train schedules are being just as closely observed as passenger train schedules and, in order to prevent delays on the line due to passenger train interference, set schedules have been made up which facilitate the work of inspection as well as diminish the operating delays.

One critic takes exception to the elimination of intermediate inspection for the reason that "in this day of high speed a chance is being taken." What intermediate inspection do passenger trains receive? They travel over thousands of miles and make three and five minute station stops with only casual observation being made by car inspectors to determine that nothing is dragging. If this can be done in high-speed passenger service, what is to prevent its successful functioning in freight service?

Still another writer asks why the inspection is not made on the outbound movement instead of when trains arrive in the yards. For the reason that hot boxes, over-heated wheels, etc., can be more readily detected and to eliminate switching bad-order cars out of made-up trains, which can be done at no additional expense when inbound trains are handled.

Another question which was raised was in connection with the inspection of air brakes, which, as set forth in the article, is being handled on the outbound movement. Trains arriving in yards with cars on which air-brake trouble has been experienced usually have the cars carded or some report is made by the train crews. These cars should be shopped out of the trains by the car inspectors, as well as cars having the air brakes over-due for cleaning. Therefore, there is small possibility that two air-brake repair men cannot correct air leaks and otherwise prepare the train for despatching in the time allowed.

THE AUTHOR.

Millenium in the Car Department

CLEVELAND, O.

TO THE EDITOR:

I have read with considerable interest the article in the January issue of *Railway Mechanical Engineer* entitled "Inspecting the Main Tracker for Long Runs" and I am wondering whether the article is based on theory or on fact? If it is based on fact, the millenium has apparently arrived on that author's railroad. How fine it would be if we could tell the transportation department to arrange to operate trains on 1½-hour intervals, or whatever interval would be necessary to give us time to handle the required number of trains each day. I can imagine how quickly some mechanical people would be consigned to the scrap pile if such a request were made of the timecard makers.

My experience in inspecting cars in train yards and terminals indicates that at a given point on most roads some one trick gets most of the trains and another trick is usually light. Unless trains are spaced evenly throughout the day the same force will be unable to maintain the inspection of trains on each trick and no given set-up of inspection forces can be assigned. I doubt that any force that is not elastic (by elastic I

mean susceptible to augmentation through adding men from auxiliary forces can successfully man a train yard for inspection of trains and maintain any definite schedule so far as the time per train is concerned.

The author of the article in question does not make any allowance of force or time for the inspection of trains after they have been switched or classified. For a train that is to travel a long distance without further inspection, and which gets its only inspection on an inbound movement, he is taking a long chance on running a train without inspection after make-up. In this day of high speed and hump switching nearly as many defects develop in making up a train as are developed in a 500-mile road movement. It would seem more logical that the inspection should be made after the train is made up, and not before, if he cannot spare the time for a preliminary inbound inspection as well as a good outbound inspection.

With the great rivalry that exists between competing roads for traffic it is absolutely necessary that the terminal time of trains be cut down. This terminal time of course includes time for inspection and repairs as well as the switching of trains and I cannot help but feel that the writer of the article is trying to "kid" somebody when he talks about using 1½ hours for car inspectors and light-repairmen to go over the train on its inbound movement; then time out for switching and a further 45 minutes for air-brake inspection and repairs, and oiling and packing of boxes. This will amount to almost four hours terminal time, and very few large roads will allow this much terminal time.

If the inspection is to be made on the inbound movement, it seems that only a cursory examination should be given the trains at that time and then only for defects which would cause a car to be shopped. An inspection of this nature could be made while the cars were being "bled."

The real inspection and light-repair work should be made after the train is switched and a sufficient force of inspectors and repair men should be assigned so that the inspection and repairs could be completed by the time the oilers, air-brake men and other workmen had completed their duties; that is, in the 30 to 45 min. By handling trains in this manner an hour and a half would be cut off the terminal time of the train.

It would be interesting to have comments from other car-department men indicating their reactions to this article, particularly from men on roads where traffic is heavy and high-speed terminal movements of freight trains are made every day. I may be wrong in my contentions regarding the inspection of main trackers and would welcome the privilege of profiting by the opinions of some other car men on this article.

R. R. HOWARTH.

Sixteen Trains in 24 Hours?

ISLAND POND, VT.

TO THE EDITOR:

The question of the feasibility of two air-brake inspectors properly handling sixteen 100-car trains in 24 hours, referred to in an editorial in the February issue of the *Railway Mechanical Engineer*, sets me to thinking about the many angles of the problem and about the diverse conditions under which mechanical and air brake inspectors must work.

It is absurd to suppose that in the climate generally associated with oranges, grape-fruits and Death Valley

the same hardships prevail as are found in northern Vermont. Three feet of snow is not exceptional under normal winter conditions here. Yesterday the temperature stood at 32 below zero at 3:00 a.m. Imagine, if you can, the lot of a car inspector working with a northwester blowing, blinding snow driven by a 30-mile wind, and often crawling knee-deep in snow down the length of a 100-car train; trucks, air hose and, in many cases, the cars a mass of ice and frozen snow.

Another matter. Did the editor mean the men should thoroughly inspect and repair according to A. R. A. rules and the railroad company's regulations, or did he mean the men should run a Marathon down the side of the train and give the engineman the highball?

If the inspector conscientiously performs his duties, they are legion. A hundred cars are assembled on a track; they have come from numerous sources, such as flour mills, coal plants, oil refineries, lumber yards, pulp mills, phosphate works, or any one of a hundred other industrial plants. About 30 per cent of these on our division will be average empties. Now the inspector's fun starts. He must inspect the interiors of all empties and card them for commodities, a job requiring time, care and keen observation. Protruding nails and bolts, leaky roofs, unsanitary conditions, and a dozen other things must be noted and the cars classified and carded accordingly. Have you ever tried to open the side doors on some of these cars under winter conditions? It takes muscle, occasionally backed up by a good steel bar. Add to this an insecure footing, and—well, give it a trial. In the meantime valuable time is slipping by.

Now for the outside inspection. Top, ends, sides and underneath must be carefully inspected. It's a great life poking under a string of cars and occasionally grabbing a handful of snow to rub the 30 below out of your nose. The advantage is that in stooping to inspect, one is nearer the snow. It is beyond comprehension where all the box and column-bolt nuts go to, assuming they are put on properly in the first place. We have not yet reached the millenium, referred to at the interchange meeting some years ago, when all cars are equipped with cast truck sides. Operating-lever clevises and pins, broken knuckles and knuckle pins, lock blocks, or what have you, often have to be replaced. Brake travel must be maintained to standard, broken brake-beam hangers replaced, air hose changed or gaskets applied as necessary, brake shoes put on and keys applied where required, and all hose finally coupled up after cutting out the occasional cripple for the rip tracks. When completed the train must be stretched and the defects thus disclosed corrected.

Now about material. I have frequently called a car inspector a walking hardware store. Even then he cannot carry many of the articles necessary for repairs on one of these 100-car trains you refer to. Equipment boxes conveniently located containing journal packing, brasses, jack, and all other emergency material are provided. This, however, means walking some distance to obtain the material and returning with it to the car and presently returning the tools and salvaged material to the equipment box. This takes more minutes of the valuable time.

Then what about heater cars? The temperature must be noted and heaters given attention, or changed where necessary. Did you ever climb down one of these heater compartments to inspect heaters? Sometimes the going isn't so good, particularly if one weighs around 225 lb.

It takes time to record all the data and make out the cards. More time is necessary to get in touch with the yard master's office and notify regarding cripples to be cut out owing to wheels with chipped rims, slid

flat, broken flange, shelled-out treads, or broken sills, draft timbers, or arch bars, or any other cause, any and all of which it has taken time to locate. Again you cannot always get your train stretched for the leak tests just when you are ready. The unforeseen is always just around the corner.

My opinion is that the inspectors and air brake men would be "busy guys"! Summer conditions here are, of course, less strenuous for the men, but even then if defects are recorded, repairs made, cars carded for commodities, cripples cut out, heater cars properly examined, etc., I, speaking personally, would be well satisfied with results if the standard set by you could be maintained.

PRACTICAL.

What the Exhaust Energy Does

NEW YORK, N. Y.

TO THE EDITOR:

Your editorial on Grates, Combustion and Draft in the February issue of this paper, and F. P. Roesch's interesting article should certainly receive widespread attention and form the basis for valuable discussion.

The results obtained by restricted air openings in locomotive grates are clearly explained in the last column of Mr. Roesch's paper. Reduction of ashpan losses calls for smaller individual openings; this, in turn, means a smaller free passage for the air as governed by mechanical requirements. In the special cases mentioned, the total air opening was indeed cut down to 12 to 15 per cent of the grate area. Objections to this practice lose

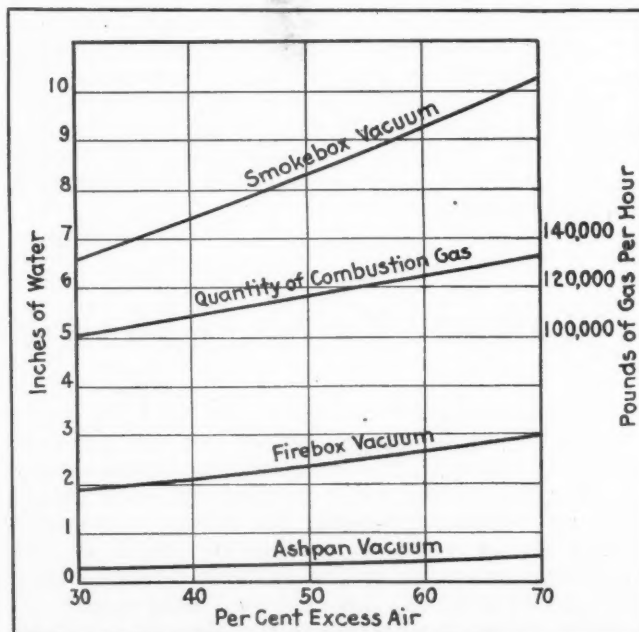


Fig. 1

at once in weight when we consider that the free passages through the fuel bed hardly ever exceed 30 per cent, and this with a complicated flow as compared with the straight flow through the grates. But still this restriction brought the resistance to the air flow resulting from the grate up to the resistance offered by a good fuel bed, and had the apparently very beneficial effect of becoming a controlling factor for equal air distribution over the whole surface.

It is here that I see the root of the problem: The restricted grate effectively controls the distribution of the

air, but not the total amount of air admitted for combustion.

The editorial suggested the predominance of other resistances encountered by the gas flow on its way through the boiler, and a careful analysis thoroughly justifies this view.

The diagrams throw some light on the question of how far the amount of combustion air can be controlled by grate resistance. Fig. 1 shows the amount of gas developed in a large locomotive boiler with about 80 sq. ft. of grate, generating 50,000 lb. of steam per hour (combustion rate about 80 lb. of coal of 13,500 B.t.u. heat value). It is plotted against the excess air admitted for complete combustion. Further, the vacuum in ashpan, firebox and smokebox is given. Naturally, a stronger draft is required for more excess air. The combined resistance of the grate and firebed shown may be called normal, but will sometimes be found even less. Air open-

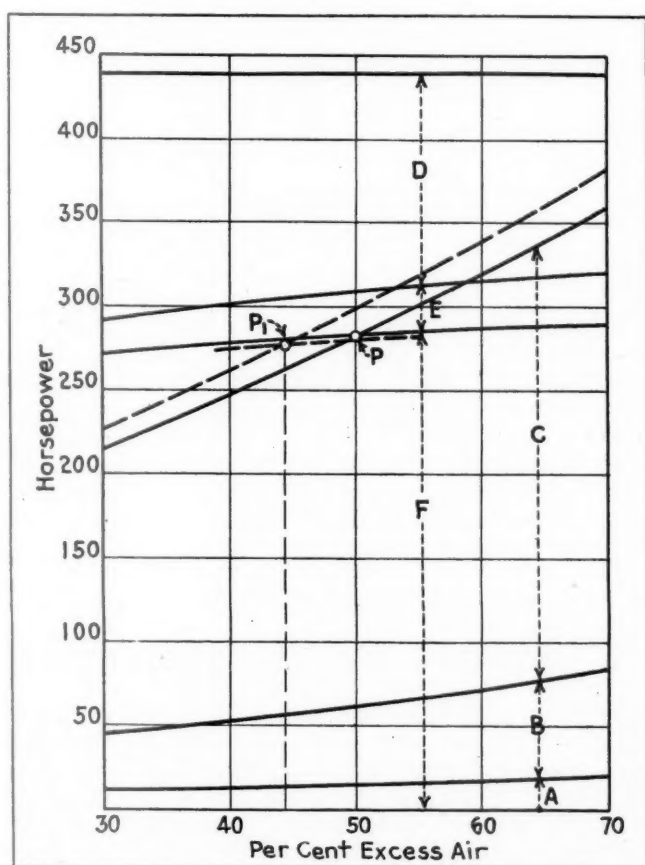


Fig. 2

ings total 50 per cent in this case. Fig. 2 deals with energies. For a given amount of excess air, a certain volume of gas has to be discharged from the smokebox against the higher atmospheric pressure. Part of this pressure difference is due to the resistance of grate and firebed, and *A* represents the amount of work in horsepower which would be performed in discharging the gases if no other resistance than that of grate and firebed existed. The other obstacles to the air and gas flow, offered by ashpan, tubes, arches and smokebox arrangement, call for the additional performance *B*.

Now the combustion gases, mixed with steam, must be discharged from the stack at high velocity. In this case, with a 21-in. stack, the work required is shown by *C*. This is the dominant factor.

The total work, $A+B+C$, has to be performed by the exhaust steam. Escaping from a nozzle of 40 sq. in.,

the exhaust contains 440 h.p.; the amount *D* is lost, mainly from the shock occurring at the mixing of the steam and gas flow at different velocities, and the amount *E* is required to discharge the volume of steam against atmospheric pressure. Finally, *F* horsepower is left to accomplish the total work, $A+B+C$, and at point *P* the balance between required and offered energies is reached, representing 50 per cent of excess air for the fire, which is a desirable average.

Let us now install a highly restricting grate with two inches of additional resistance at this moderate combustion rate, or more than twice as much as in Mr. Roesch's example. Other conditions remain unchanged, only somewhat more energy is required to discharge the exhaust steam owing to the higher smokebox vacuum. The new balance will be reached at *P*₁ with 44.5 per cent of excess air, and the total air supply has been reduced less than four per cent by this highly restricting grate.

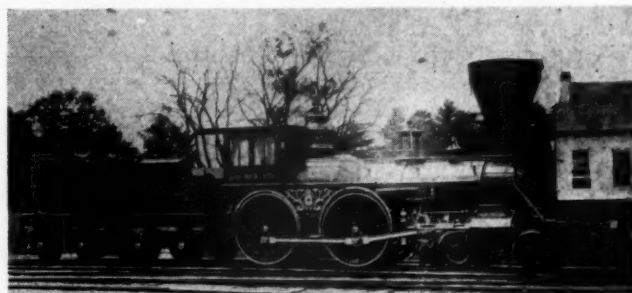
This makes the case clear; the amount of combustion air cannot be controlled to advantage by grate resistance. But, as tests have shown, air distribution can be controlled by establishing a constant basic resistance all over the surface and reducing the haphazard effect of the fuel bed. To this end, some existing forms of grates other than the round-hole grate will probably be more desirable from a combustion standpoint, especially with very thin fires, but here the properties of grate material and coal enter.

Fig. 2 also serves to answer the second point in the editorial on back pressure. With the beneficial effect of a restricted grate for maintaining a thin firebed firmly established, the expense involved in back pressure seems fairly moderate; at any rate, there are a number of other points where we can attack the problem of back pressure, enabling us to afford some sacrifice for improving conditions in the firebox. It is natural, however, that no more restriction should be allowed than consistent with sufficient draft equalization. Excessive air supply is a rather rare malady with our locomotives, but reduction in front-end draft should be the remedy in such a case.

In connection with the Bureau of Mines test referred to by Mr. Roesch, the question might be asked, "Offering only a fraction of the total resistance to the air flow, why, then, has the height of the fuel bed such a considerable effect upon combustion?" The qualitative answer is simple and can be easily demonstrated with a stationary chain grate and forced draft. In a higher fuel bed, more coal is burned per unit of time even with the air supply kept constant, resulting in less excess air and, eventually, bad combustion. Once clinkers are formed, the resistance may rise to any amount. The quantitative answer, however, offers good opportunities for extended investigation.

DR. A. GIESL-GIESLINGEN.

* * *



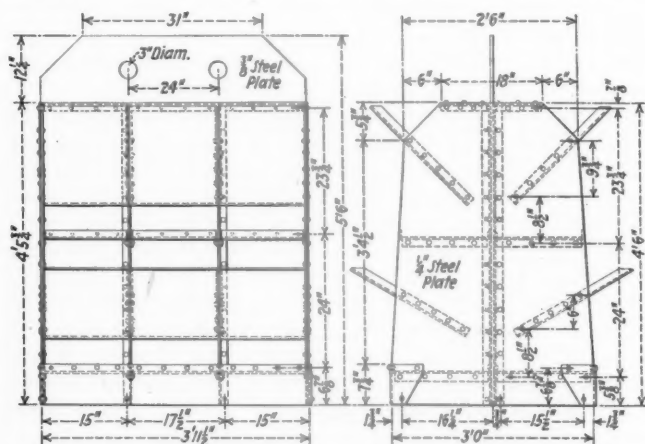
From collection of W. A. Lucas

Atlantic & Great Western built by Danforth Cooke & Company in 1862

With the Car Foremen and Inspectors

A Useful Rivet Rack

A RIVET rack that is easily transferable and very useful for storing rivets in close proximity to extensive riveting operations in car and tender shops is shown in the following drawing. It is made entirely of steel plate, is 3 ft. wide, 3 ft. 11½ in. long, 4½ in. high



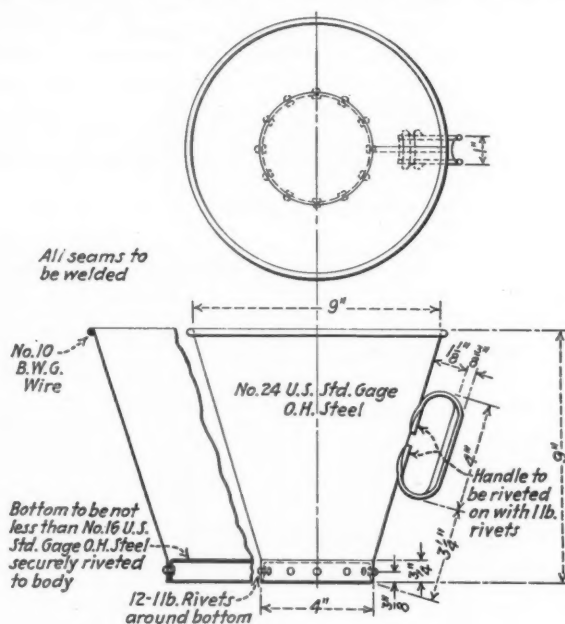
The details of the rivet rack

and contains 12 bins. A unique feature of the rack is the attached slides which facilitate filling the various bins. The rivets thrown onto the slides partially fill the bottom of the bins but a majority of them remain in that section above the slide, falling towards the bottom as the rivets are removed for use. As shown in the drawing, the 3/8-in. section of steel plate forming the back of the bins, extends 12¼ in. above the rack and has two 3-in. diameter holes burned out 24 in. apart to facilitate its being moved from place to place by overhead or portable cranes.

Special Bucket for Handling Hot Rivets

IN some operations of riveting it is advantageous for the heater to throw hot rivets to the men on the job rather than to carry them to awkward locations and place them into position himself. For the benefit of the man catching the rivets, one railroad has designed a bucket which is not only light in construction, is built to withstand the hard service of riveting operations and is very durable. The bucket, shown in the drawing, is made of No. 24 U. S. Standard gage O. H. steel beaded at the upper rim with No. 10 B. W. G. wire and has a bottom made of No. 16 U. S. Standard gage O. H. steel which is secured by 12 1-lb. rivets. The handle is made of the same material as the bucket and is attached to it by means of two 1-lb. rivets. All the seams of the bucket are welded. The bucket is 8¼ in. deep, 9

in. in diameter at the top and bevels off to 4 in. diameter at the bottom. It makes a convenient device for this kind

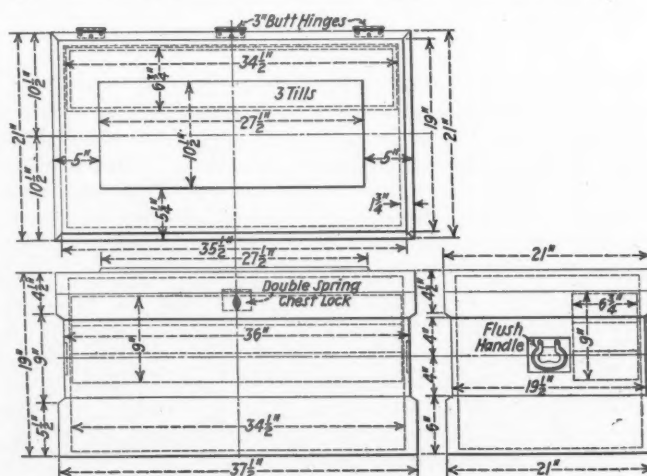


A bucket specially designed for handling rivets

of work and has increased the safety with which rivet throwing can be handled.

A Toolbox for the Apprentice

BECAUSE of the diversified work to which passenger-car apprentices were assigned and the difficulty they experienced in moving their tools from place to place, the toolbox, shown in the detailed drawing, was developed and issued as standard equipment to all such apprentices by a Southeastern railroad. It serves as an



A toolbox for car apprentices

adequate means of keeping a large assortment of tools in a small but compact place and is so constructed that it is easily moved from one department to another. The box is 21 in. wide, 19 in. high, and $37\frac{1}{2}$ in. long and is equipped with a sliding tray 9 in. high and $6\frac{3}{4}$ in. wide that runs the entire length of the box. The top is attached by means of three butt hinges and is secured by a double-spring chest lock. To each end is bolted a handle, so designed that it is flush with the side of the box at all times when not in use.

A Storage Bin and Knuckle Rack

THE knuckle rack and material storage bin shown in the drawing has proved to be of such an aid to car-repair yard practice that one road has recently adopted it as standard equipment for its yards. The rack consists of a platform 9 ft. wide and 16 ft. 1 in. long on which is erected the housing for material-storage and the angular racks for knuckles. The structure is 7 ft. $9\frac{3}{4}$ in. high, 6 ft. 8 in. wide and is so designed that the opposite sides of the housing are identical in construction.

The storage bins, 2 ft. $1\frac{1}{4}$ in. deep and 2 ft. 10 in. wide, are situated 4 ft. above the platform and are protected by 14-in. eaves. The 4 by 4-in. vertical skeleton timbers are braced by 4-ft. $4\frac{1}{2}$ -in. sections of tubing that are belled or riveted on the ends to prevent their withdrawal from the posts. The roof is covered with three-ply paper roofing. The knuckle racks consist of 2-in. by $5\frac{1}{2}$ -in. timbers set at an angle against the structure and running from a point 12 in. from the edge of the platform to the base of storage bins where they are secured by $\frac{1}{2}$ -in. carriage bolts. The slanting timbers of the racks have a vertical height of 3 ft.

$7\frac{3}{4}$ in. and are placed 7 in. apart, thus forming a convenient receptable for car knuckles.

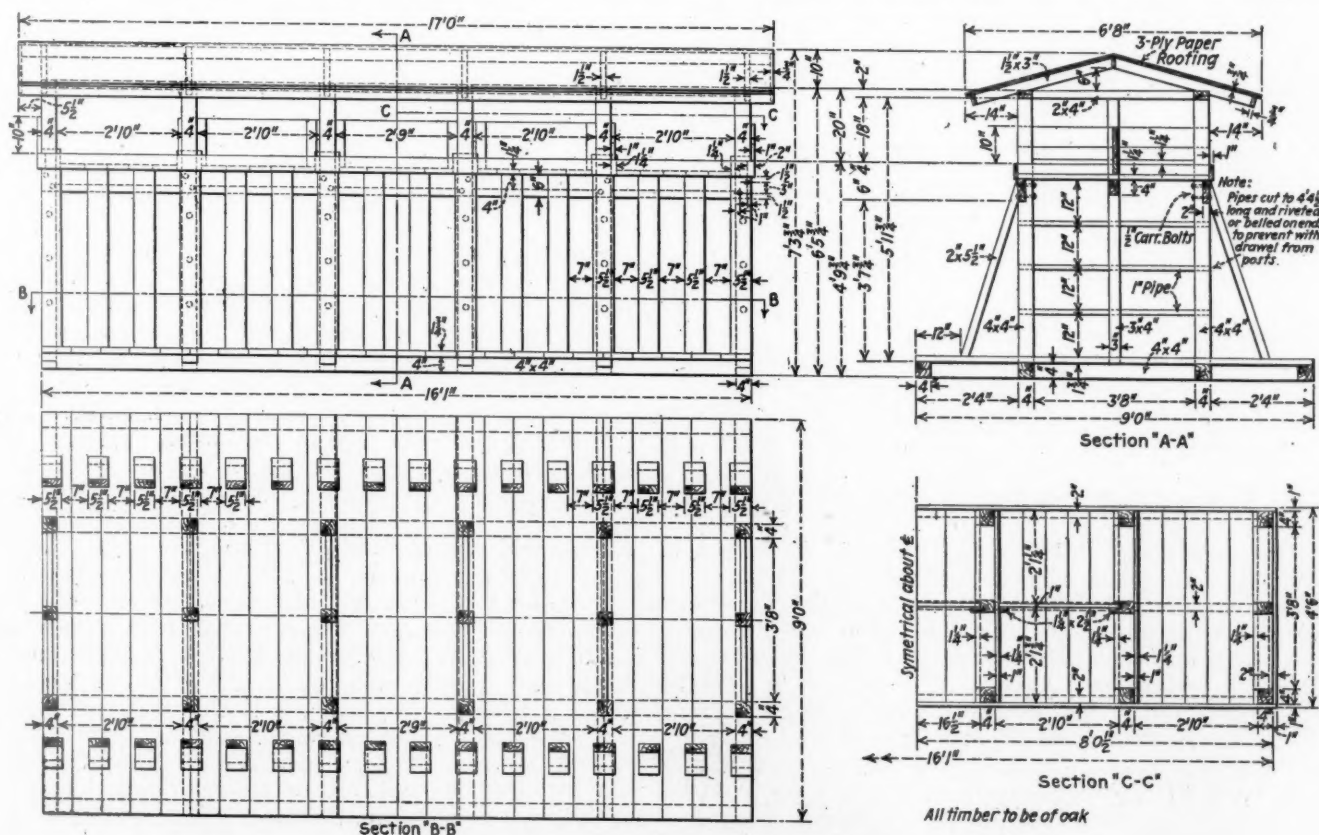
The structure has 10 storage bins and 30 racks and has been found to be an orderly and economical method of storing small car-repair material and knuckles. The satisfaction given by the racks has warranted its adoption as standard equipment for car-repair yards on the road which developed its use.

Decisions of Arbitration Cases

(The Arbitration Committee of the A. R. A. Mechanical Division is called upon to render decisions on a large number of questions and controversies which are submitted from time to time. As these matters are of interest not only to railroad officers but also to car inspectors and others, the Railway Mechanical Engineer will print abstracts of decisions as rendered).

Billing on Authority of Defect Cards

While Wabash car No. 76299 was in the possession of the Kansas City Southern it was damaged in collision between cars being handled by engines of the Kansas City Southern and the Texas & New Orleans. The latter road admitted responsibility for the collision and issued its defect cards to the former road, covering all damage sustained by the car as set forth in the Joint Inspection Certificate. At the completion of repairs the Kansas City Southern billed the T. & N. O. which took exception to a charge for a complete K-2 triple valve because the defect card allowed for a K-2 check case and a K-2 cap, only. The repairing line contended that it was found necessary in making repairs to apply a



Details of the knuckle rack and storage bin

new triple valve because the one removed was beyond repair. It was the contention of the T. & N. O. that the Kansas City Southern should have renewed only the items covered by the defect card plus a charge per Item 29 of Rule 111 for C. O. T. & S. air brakes, and that if parts of the triple valve other than those specified on the defect cards were broken, requiring the renewal of the entire triple valve, the Kansas City Southern should have secured additional protection for such damage from the correct authorities on the Texas & New Orleans.

The following decision was rendered by the Arbitration Committee: "Charge for repairs to triple valve (which includes renewal of check-valve case and cap), as well as the cleaning and oiling of the triple valve and brake cylinder, including testing and stenciling per Rule 60, should be \$4.14 as per Item 29 of Rule 111.

"If the triple valve body was damaged, it should have been specified on the defect card to justify charge for the renewal of the same."—*Case No. 1620—Kansas City Southern vs. Texas & New Orleans.*

A Case Covering Stenciling of Reweighed Cars

The Michigan Central executed joint evidence cards during March, April and May, 1928, certifying to the fact that old weight stenciling had not been entirely painted out on its cars 64974, 94895, 99705, 91194 and 63299 at the time of the last reweighing of the cars, as provided in Section 6 of A.R.A. Rule 30. The repair cards of the Chicago & Alton showed that it had last reweighed these cars from five to fifty-seven days prior to the owner's inspection. Therefore, claims were presented to the Chicago & Alton for defect cards to cover the cost of restenciling the cars. The Chicago & Alton declined to furnish the defect cards on the ground that it was not responsible for wrong repairs. The owner stated that Section 6 of this rule provides that "the old weight stenciling marks should be entirely painted out with quick-drying paint", which would seem to be a clear and definite requirement of the rules and one that must be complied with. The Chicago & Alton contended that it had been the practice of railroads in general, with a few exceptions, to paint out only the numerals to be changed in remarking light weight and load limits, where the old marking showed up bright and clear.

In rendering its decision the Arbitration Committee stated: "Rule 30, as well as Circular No. DV-568, contemplates that when cars are reweighed, the old weight markings should be entirely obliterated and the car restenciled. Joint evidence per Rule 12 is proper."—*Case No. 1621—Michigan Central vs. Chicago & Alton.*

Removed Axle Below A.R.A. Standard

On September 23, 1927, the Louisville & Nashville changed wheels and axle R. & L. 3 under Chicago & Alton car 22387 on account of a cut journal. Two second-hand wheels and one axle, 5-11/16 in. at the center, were removed and two second-hand wheels and one second-hand axle were replaced. Because the center dimension of the axle was less than the limits for an A. R. A. standard axle, the L. & N. rendered a bill to the C. & A. for the difference between the non-A. R. A. axle removed and the second A. R. A. axle applied. To this charge the C. & A. took exception, claiming that the axle removed was a scrap A. R. A. axle and not a non-A. R. A. axle. The owner, in support of its

contention that the removed axle was scrap, presented the original billing repair card of the New York Central which applied the axle in question on April 8, 1924, showing it to be a standard A. R. A. axle with a center diameter of 5-7/8 in. The owner further contended that, inasmuch as the axle was an A. R. A. standard axle when it was applied, it would be an A. R. A. standard axle when removed, even if the center diameter had decreased some in the three-year interim. The repairing line contended that the charge as rendered the car owner for a difference in the value of the axles removed and applied was proper and in accordance with the second paragraph of Section (b) of A. R. A. Rule 86, on the ground that an axle, the dimension of which is 5-11/16 in. in the center, is a non-A. R. A. axle and not a scrap A. R. A. axle as contended by the C. & A.

The following decision was rendered by the Arbitration Committee: "Rule 86, Section (a), does not recognize axle having 5 1/2 in. by 10 in. journals as non-A. R. A. standard. It is assumed that the axle in question originally conformed to the A. R. A. standard and, therefore, Section (b), second paragraph, Rule 86, does not apply. The contention of the Chicago & Alton is sustained."—*Case No. 1622—Chicago & Alton vs. Louisville & Nashville.*

Fair and Unfair Usage Items Repaired at Same Time

St. Louis-San Francisco car 125751 was repaired by the Illinois Central May 19, 1927, charges amounting to \$6,215.37. The following repairs were made and marked "No bill, derailed":

A—Car jacked.
A. R.—1 new Bettendorf truck side—Account broken, ordered from owner.
R. & L. 3—1 second-hand Ajax No. 2 A. R. A. brake beam—Broken.
R. & L. 4—1 second-hand Ajax No. 2 A. R. A. brake beam—Broken.
R. & L. 3—2 brake hangers R. R. & R., 16 lb.—Bent.
R. 4—1 new 10-in. U brake hanger—Broken.
R. & L. 3 & 4—4 brake shoes and keys R. & R.—Account broken.
R. & L. 3 & 4—4 new patent 9-in. dust guards—Account repairs.

The following repairs were made and marked "Bill Owner."

A—Second-hand cast-steel truck bolster—Broken. 540 lb., ordered from owner—Old defect.
A—2 new 3/4 in. by 5 in. by 6 in. body side-bearing shims—Account clearance.
A—6 new 3/4 in. by 3 in. side-bearing bolts—Account repairs.

Exception was taken to the charges rendered in accordance with Rule 41. The Illinois Central declined to cancel the charges. The owner contended that it is not in accordance with A. R. A. Rules to allow any company to attempt to divide responsibility in cases of cars damaged in violation of Rule 32, when the defects are so closely associated as they are in this case. The repairing line submitted to the committee copies of the accident and damage-to-equipment reports which covered this accident. These reports showed that the car was derailed as the result of a truck bolster breaking in an old weld, allowing the bolster to drop down. A report of the traveling mechanical inspector of the repairing line, who inspected the bolster, reported that the weld referred to was improper in that it was made to a 100 per cent fracture, whereas Rule 23 allows only 40 per cent. Furthermore, the weld was not stamped as required, to show shop, date, etc. The Illinois Central contended that the broken bolster was the cause rather than the result of the derailment and that in accordance with the principle involved in Interpretation 13, Rule 98, and numerous Arbitration decisions, the charge was proper as rendered.

The decision rendered by the Arbitration Committee

Meet Dave and Alec

On the Firing Line

By T. J. Lewis

MR. Demarest was right, of course. The A. R. A. Rules of Interchange are plain enough for any one to understand. Alec and Dave would both agree to that, but the trouble comes when either one undertakes to show the other how the rule ought to be applied to a particular case.

Now Alec and Dave are both interchange inspectors. They work for different railroads and their interchange tracks lie alongside each other; they should ordinarily be said to work together, which they mostly do; then, again, they would be said to work "opposite" each other, which they sometimes do, seemingly, though either of them would explain that he was only trying to help the other to understand the rules properly.

They sign joint evidence for each other readily, generally with hardly a word of dissent and in most ways play the game of give and take smoothly enough until it comes to issuing defect cards. As is usual with interchange inspectors, writing defect cards is the first item on each of their lists of things not to do until the last inch of ground has been fought over and the last shred of evidence has been displayed to the best advantage.

Just a week or so ago there was a case concerning a bill for repairs which Alec had made to the door of a stock car belonging to Dave's road. Dave felt that Alec had gotten the better of him that time, but he determined to bide his time and when his chance did come—as he knew it would—wouldn't he make old Alec sweat!

So, yesterday morning Alec and Dave met at the interchange as usual and both went to work. The second car Alec came to was empty and had a big hole in the door. He went to the corner of the car, squinted at the pool marks, glanced up at the number of the car, then began turning the leaves of his record book backward, carefully tracing down the lists of car numbers recorded there as he did so. Soon he found what he was looking for and stopped. Holding his finger against the number in the book he glanced again at the number of the car; then, slipping the book in his pocket, he turned to a car on the next track, the ladder of which happened to be opposite the door of the car being inspected. Up the ladder he went until he reached a level with the hole in the door. After taking a good, long look at the edges of the hole, he called out.

"Oh, Dave! Come over here a minute."

Dave knew from the sound of Alec's voice that Alec thought he had found something, so he took his time coming around the end of the cut of cars on Alec's track. Half a thought of the stock-car door flashed through his mind and he resolved not to help Alec get excited over whatever it was he had found. So Dave, assuming an air of nonchalance, slowly approached, filling his pipe as he came.

"What's the trouble, Alec?" he said.

"What's this you're trying to gimme?" asked Alec, hanging to the grabirons and indicating the damaged car with a nod of his head.

"Well," said Dave, "If I had just one guess, I'd say it's a car. Looks like one to me."

"It does, does it?" asked Alec, a little nettled at Dave's lack of interest. "Well, it looks like a part of a car to me and no guessing about it."

"It does, does it?" quoth Dave, in such an unmoved tone as to exasperate Alec greatly.

"Come up here where I am, Dave, and you can see what I mean" insisted Alec. Dave struck a match and quietly contemplated the car over his cupped hands as he lighted his pipe, and then—"I see what you're talking about, Alec—just a little hole in the floor—don't amount to anything; car's on its way home, empty, anyhow."

"Don't amount to anything, huh!" exploded Alec, "Well, you just come up here and you can see for yourself that the hole was cut in that door, Dave."

"What!" said Dave, his quickened interest almost overcoming his intention to appear indifferent. Then recovering himself, he climbed upon the ladder with Alec and after looking critically at the damaged door said, "Well, I'll be durned! That hole was cut part through with a pocket knife from inside, then busted out, wasn't it?"

"Yes" agreed Alec, "a 'bo got shut up in the car, no doubt, and that is the way he got out. Look, there is a shred of his clothes on that splinter."

"He had a blamed good knife" said Dave, "and don't you know he cussed when he tore his pants!"

Alec climbed down to the ground and so did Dave. Dave remarked good naturedly, "Ain't it strange, Alec, all the different ways a car can pick up little damages on a trip?"

"Yes, it is," assented Alec, "but that can't be considered such a little damage. It's practically a new car and that big hole in the door puts it out of business as far as loading is concerned until it is repaired."

"Oh, well," said Dave, in a tone calculated to belittle the matter, "just a matter of six door boards; besides, the car's on its way home empty. Don't amount to much." He was anxious to stave it off if possible, but he felt that Alec was going to say something disagreeable just as soon as he could work himself up to it. It came sooner than he expected, for just then Alec half turned away, as if the case was closed, and said:

"Well, Dave, you can card it right where it is or I'll set it back and you can repair it—either way you like."

This remark of Alec's, together with a stray thought of the stock-car door which flashed through Dave's mind at the same time riled him good and plenty, and he blazed out, "Uh! I can, can I? Well, I must say it's mighty blamed nice of you to give me any choice at all in the matter, instead of telling me outright just what I've got to do. Of course, just as you say, I could do either one if I liked, but I don't, and I ain't. The very idea of running that car three miles to North Yard Shop just to get that little old hole patched is ridiculous. I haven't got the material here to repair it with and as for carding it, there just isn't nothing doing

AT ALL! Maybe that's some satisfaction to you, and that's all I've got to say about it."

This red-hot tirade of Dave's, bursting out so suddenly, caused Alec to boil over. They were both stamping around on the ground somewhat like two cocks in a pit, manoeuvring for position. Alec had his record book clinched in his hand 'til the corners flared out and Dave bit his pipe stem so that it was in danger of snapping off.

"You don't need to say any more, not another word," Alec snapped out between his teeth, "I'll just set it right back and you can keep it 'til it rots for all I care. It's a plain case of delivering-line responsibility and if you think it's going to come on this man's railroad like it is, then you're due to have another thought coming, whether it ever comes or not."

"Delivering-line responsibility, huh?" roared Dave, "where do you get that? There ain't any hint of a Rule 32 condition about it,—it ain't been derailed, nor sideswiped, nor cornered, nor anything of the kind."

"No Rule 32 condition about it, is there?" Alec came back, "you just get out your rule book and turn to page 70 and read the fifth paragraph and learn something—"

"I don't have to get out no rule book," Dave cut in. "I know what you're driving at. You mean where it says 'removing or cutting out parts of cars to facilitate loading and unloading,' but you know as well as I do that loading or unloading didn't have anything to do with making that hole in that door."

"How come it didn't?" asked Alec. "You know darn well that the car wasn't empty when that hole was made in the door and, call it load or whatever you please, it came out of that hole—that rag on that splinter helps to prove it. Then, how else can you figure it out but that the hole was made in the door to facilitate unloading? Plain case of the fifth paragraph of Rule 32 and you can't make anything else out of it."

While Alec was snapping this out, Dave nervously stamped around on the ground and broke half a dozen match stems in a vain endeavor to relight his pipe. The instant Alec paused he cut in with "Just wait a minute, Young Fellow! Just wait a minute! We just received this car from you less than a week ago, loaded with stoves for Billingsley, forty miles up the road; went up there, was unloaded and sent back, supposed to be empty, but you want to consider that one lone hobo a load. Alright then, according to your own claim, the door was broken out by the load which makes it purely owners' defects by the rules—"

"Yes, but, dammit! Dave, that's different—," Alec cut in.

"Different, nothing!" Dave roared. "If the whole end of the car had been broken out by the load it would still be owners' defects, and you know it."

"Any one would know that," said Alec, disgustedly. "They'd also know that there is all the difference in the world in the end of a car or the door either being broken out by the load shifting and in it being cut out. Why, Dave, just a few days ago didn't I give you a defect card for four boards cut out of the end of a car to load and unload lumber through?"

"Yes," said Dave testily, "because it was such a plain case, you knew there was no use in arguing. I also remember just the other week when you rebuilt a door on one of our stock cars and billed us for it, and that stock car door was kicked out by a blamed mule, and when I said you had no right to bill for it, you said, 'Oh, yea, that's owners' defects, the door just wouldn't stand the pressure,' and now you think I'm going to card for that hole. Well, I'm not."

Dave felt that he had the case pretty well sewed up

and followed up with: "If you're going to claim that this hole was cut to facilitate unloading, then you are bound to admit that the hole in the stock car door was made for the same purpose."

"Then," said Alec, "I guess you want to claim that this hole was made in this door by the load shifting, do you? Why, the very idea is ridiculous! This car was cut for a purpose and the purpose was to unload. You can't get away from that, no way. Plain case, fifth paragraph, Rule 32, page 70."

Alec just knew he had Dave floored for the count that time, but Dave was so mad he could scarcely speak and blurted out, "You go to the devil!" Then as soon as he could speak he came back again: "Both cases just exactly alike, both shut up in a car, hobo cutting to get out, mule kicking to get out. Hobo got out; mule would'a got out if you hadn't stretched a truck chain across the door 'til the pusher could get the car to the pen and unload 'em. Cases identically the same. Why, that blame mule would'a probably left a piece of his hide on the splinter of the door just to prove to such fellers as you what he was kicking for."

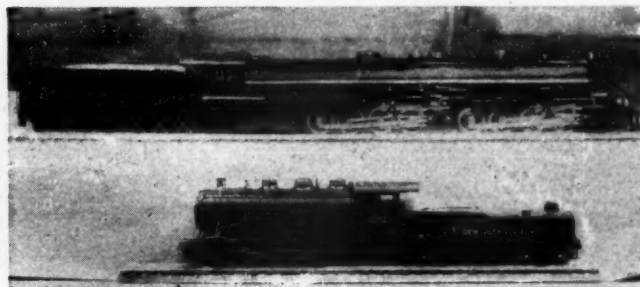
Dave turned away as he fired this last broadside, and shot Alec a contemptuous glance over his shoulder as he left the scene. Alec snatched a set-back card from his pocket, tacked it on the car and almost cut it to shreds with his pencil as he filled it in.

They did not meet again during the day, but this morning when Alec got to the interchange about the first thing he saw was the same car back on his track again. The hole in the door was boarded over and both doors closed and pieces of broken seal neatly twisted on the door locks. The second shift had accepted the car, and, turning to the record in the interchange book, Alec read, "Damage to door boarded over, R. side."

A grin crinkled Alec's face, followed by a whimsical look. Then he stepped back, looked up at the door and at the seals and laughed outright. He felt as if he would like to kick the seat of Dave's overalls out and give him a friendly slap on the back at the same time.

PENNSYLVANIA RAILROAD stockholders are continuing to grow in number. A new high record of 191,079 registered owners of shares was reached on December 1, 1929. This was the third consecutive month in which the stock rose to record breaking levels for widespread public distribution, figures for September and October having topped all preceding marks. A total of 3,032 new shareholders was added to the company's books during November. The number of holders registered on December 1 showed an increase of 36,012 as compared with the same date a year ago. A large proportion of this heavy increase in Pennsylvania stockholders is accounted for by the addition during the last three months of many new employee holders as a result of the employers stock allotment authorized by the board of directors in July, 1928. The average number of shares held by stockholders on December 1 was 59.9. A total of 11,444,324 shares, at par value of \$50 each, was outstanding.

* * *



Locomotive models built by Paul Cheske of Chicago

In the Back Shop and Enginehouse

Nickel Plate Shop Devices

SEVERAL special shop devices, developed recently and now used at the Stony Island (Chicago) shops of the Nickel Plate, have been in service long enough to demonstrate their practicability and merit in saving time on well known locomotive repair operations.

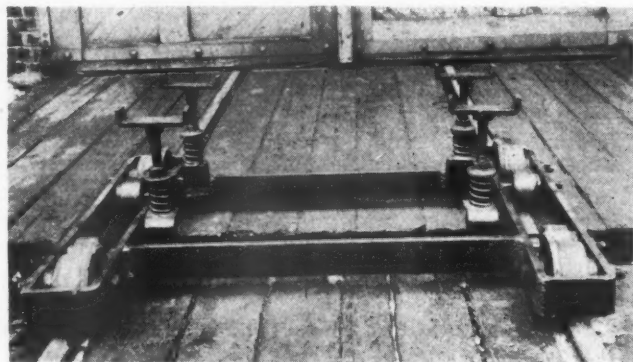
The valve-bushing puller is the result of an idea secured from an article in a recent issue of the *Railway Mechanical Engineer*, the puller in the present instance being much larger and quicker in action, but utilizing the hydraulic pump. The device for applying shoes, wedges and binders is the result of an idea secured at the 1929 convention of the International Railway General Foremen's Association at Chicago. The other devices are original with the foremen at this shop.

Valve-Bushing Puller

This is a hydraulic device that is used to pull in two piston-valve bushings at the same time, and consists essentially of a cylinder, a piston and rod and a hydraulic pump. The average time required for two men to pull in two 14-in. valve bushings is 25 min., including the time to set up the device with a traveling crane and the time to take it down. It takes about 15 min. for set-up, 5 min. to pull in two bushings and 5 min. to take the device down. This operation formerly required from two to four hours, using a screw and pneumatically-operated ratchet device.

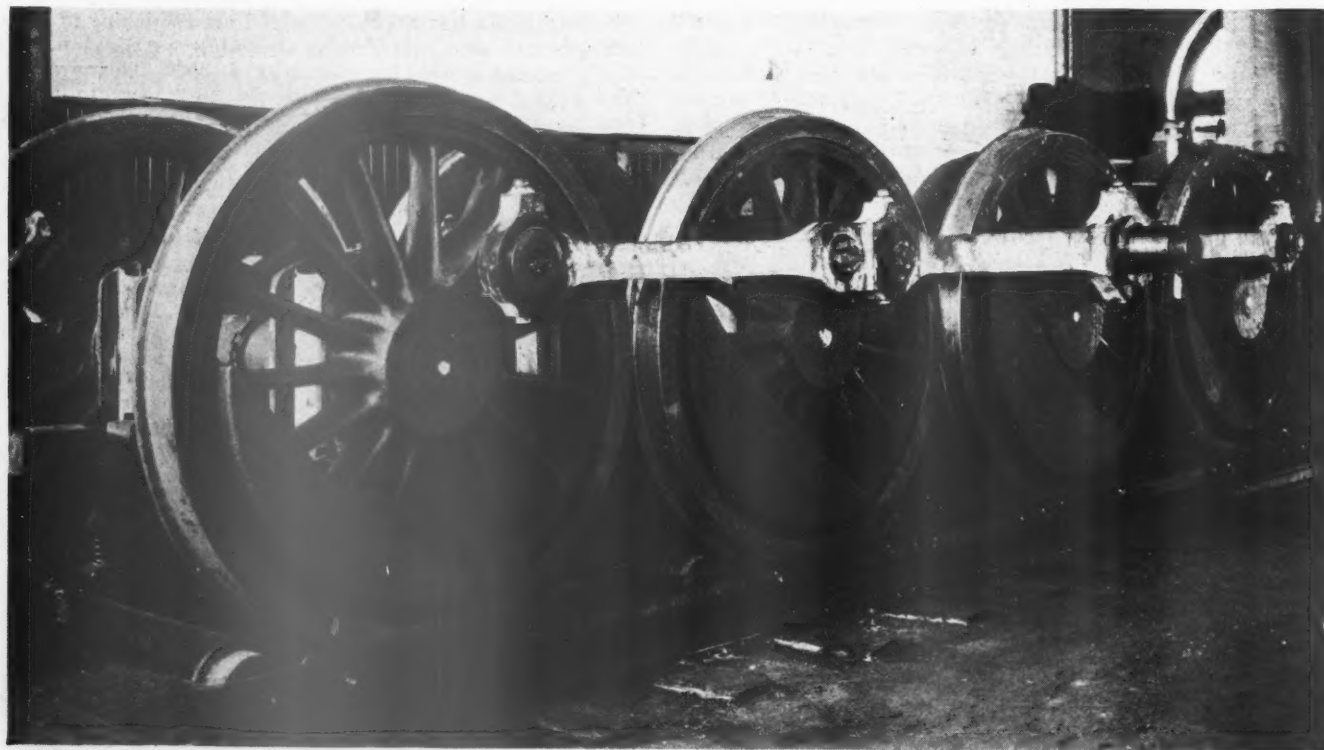
The puller consists of a piece of 12-in. extra heavy

hydraulic pipe, faced off on each end and provided with two forged-steel cylinder heads held together with 1¼-in. tie rods. The piston rod is 2¾-in. in diameter, made from 20-point soft carbon steel and has a 1½-in. by 3-in. keyway at the outer end. The piston head is made in the usual manner with leather packing on the front and back to permit operation in either direction. The hy-



Device used in applying shoes, wedges and binders

draulic pump consists of an old 8½-in. single-cylinder air pump, with the air end removed and a special water cylinder, built out of a piece of 3-in. steel tubing, secured to the steam end of the pump by tie rods. Water enters the cylinder at the bottom and the pump is of the single-acting type with two ordinary check valves in the

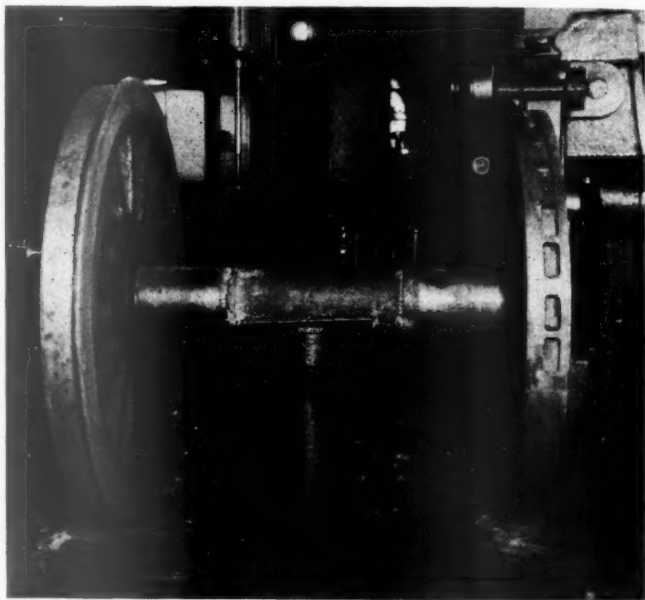


Another view showing driving wheels with side rods applied, ready for movement to the Whiting hoist via the transfer table

water pipe. A ½-in. pipe with Barco flexible joints carries the water under pressure to the puller cylinder. The return stroke is made quickly by air pressure from the shop air line.

The hydraulic pump is mounted on a small four-wheel truck which carries an old 55-gal. oil barrel that serves as a water reservoir. This barrel contains enough water to last three or four weeks, because most of the water is returned to the barrel after the bushings are pulled in.

The pump is connected to the shop air line and will

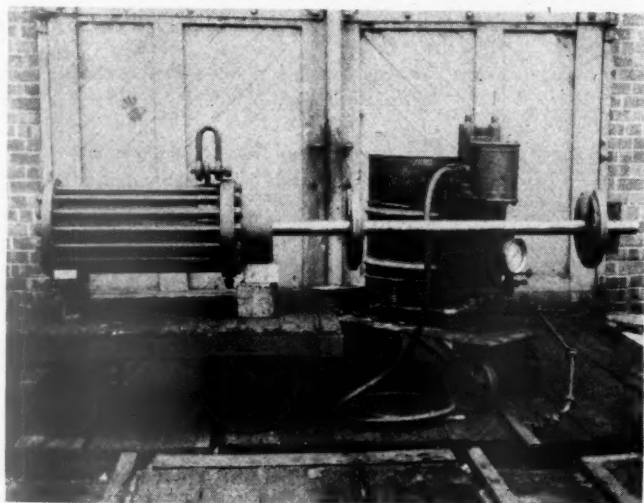


A convenient stand for holding driving wheels while applying the tires

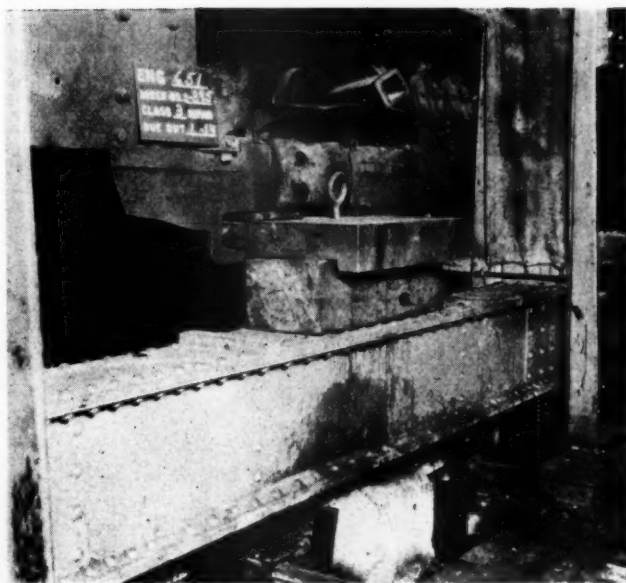
develop about 800 lb. per sq. in. water pressure or a total pull on the valve bushings of more than 40 tons.

Device for Applying Shoes, Wedges and Binders

Applying shoes, wedges and binders to the modern locomotive by hand is a heavy job and the simple device illustrated was developed to make the job easier and also to speed it up. Before the driving wheels are moved to the Whiting locomotive hoist for application to the locomotive, each pair of wheels is set on one of these trucks by means of a jib crane in the wheel de-



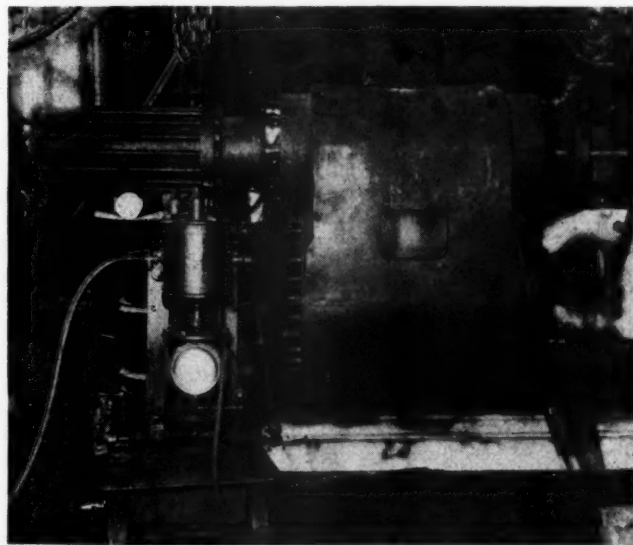
Valve-bushing puller, hydraulic pump, water storage tank, etc.



Forging inserted in the drawbar pocket for lifting locomotives equipped with boosters

partment. At the same time, the binders are set on special holders under the driving boxes, and the side rods are applied to all of the wheels. The small rollers on the truck are provided to facilitate turning the wheels while applying side rods.

After the side rods are all applied, the trucks are connected together by means of links, and then all of the wheels are moved to the Whiting hoist over a transfer table. The locomotive is lowered on to the driving



Hydraulically-operated valve-bushing puller developed at the Chicago shops of the Nickel Plate

wheels in the usual manner and at the same time the shoes and wedges are set in place so that when the engine is completely lowered, the shoes, wedges and binders are all in place.

It takes about 15 min. longer to lower the locomotive than usual when applying four pairs of driving wheels, using five men in the pit and two men outside.

The trucks were built largely from scrap material that was on hand at the time. The wheels are 8 in. in diameter and the frame is built from 1-in. by 5-in. bar iron electrically welded together. The rollers on which the driving wheels rest are 3 in. in diameter and are

made out of steel. It will be observed that the binder rests are adjustable and spring-supported to prevent breakage. By using different length of links, all classes of locomotives can be accommodated.

Device for Lifting Locomotives

On certain classes of locomotives, the trailer truck booster projects back so far that it is not possible to get the beams of the locomotive hoist under the back end



Wheels and binders in place ready for wheeling

of the locomotive and still permit the removal of the trailer truck at the same time that the driving wheels and engine truck are removed.

This situation is taken care of by inserting a large steel forging in the drawbar pocket and lifting the locomotive by bringing the hoist beam under this forging, which is made so that the drawbar and safety bar pins can be used to prevent the forging coming out.

This device has been used for several months and has proved to be an entirely safe and satisfactory method of removing the trailer truck from engines equipped with a booster.

Driving-Wheel Stand

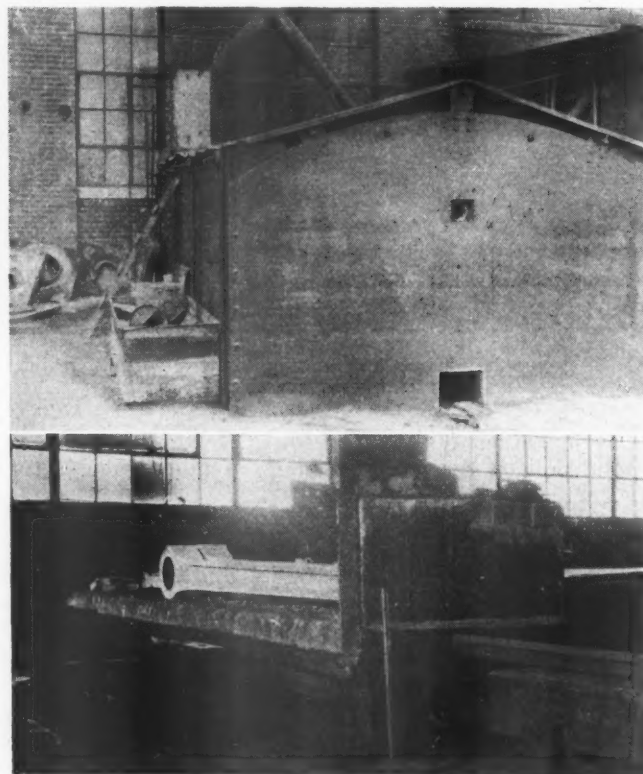
One of the illustrations shows a simple device that is used for holding driving wheels while tires are removed or applied. The stand consists of a 30-in. cast-iron truck wheel imbedded in the concrete floor and a section of driving axle set vertically and equipped with welded V-plates to support the driving axle. The bottom of the driving-axle stand is turned down so that it is a slip fit in the truck wheel and is provided with a ball bearing using 1-in. balls. The ball race is turned on the top side of the truck wheel and on the bottom of a shoulder on the driving axle. This arrangement makes a flexible and substantial stand for holding driving wheels while applying and removing tires.

APPROXIMATELY 930,000,000 passengers a year are carried by the four British railway companies within the limits of Greater London alone, according to figures recently published by the Railway Newsletter (London). To accommodate this traffic, the Southern maintains 200 stations, the London & North Eastern 98, the London, Midland & Scottish 75 and the Great Western 22 within a 10-mile radius of Charing Cross.

Furnace for Annealing Alloy-Steel Rods

TO derive full benefit from the alloy in carbon-vanadium steel side rods it has been found necessary to cool them quickly after the first heat in the annealing furnace. A new car-bottomed type of furnace has been found ideal for this purpose and much better results have been obtained with it than with the old type of solid bottom furnace. Microphotographs indicate that the proper metal structure is secured with the new furnace, as does the performance on the road.

The furnace is built at one end of the machine shop, about 6 in. from the building to eliminate the smoke nuisance. A 6-in. pipe entering the furnace at each corner of the building, furnishes air for the distribution of the oil, which enters these blowers through a small pipe. With the oil sprayed into the furnace from the



Top: Car-bottom furnace used for annealing carbon-vanadium steel rods—Bottom: The car drawn inside the shop

upper corner, the heat does not impinge directly on the rods. If one side of the furnace appears to be too hot the feed may be regulated according.

Rods to be annealed are loaded with the shop crane onto the furnace car, which is built up with fire brick, and is drawn into and out of the furnace through an opening in the wall of the shop by a return cable attached to the crane. The furnace is about 18 ft. long by 4 ft. wide and has a fire wall of brick which closes up the end of the furnace above the end wall of the car, which forms the bottom of the furnace when drawn in. After a set of rods has been drawn into the furnace, the temperature is brought up to 1,650 deg. F. and held at that temperature for one hour. The car is then drawn out and the rods allowed to cool below 600 deg. F. The car is again drawn into the chamber

and two hours is required to bring the temperature up to 1,200 deg. F. The furnace is then sealed, and the rods are not removed until the next morning when they are picked up by the crane and carried to the rod bench. It is the practice to test and anneal side rods about every 70,000 miles.

Frisco Enginehouse Mono-rail

AFTER commenting on the thorough back-shop work and locomotive improvement program carried out on the St. Louis-San Francisco in 1929, H. L. Worman, superintendent of motive power, said in a recent issue of *The Frisco Employees' Magazine*: "The result is that today our locomotive condition is better than it has been in several years. This has permitted operating locomotives over several divisions without the necessity of cutting out at each terminal for attention. On our freight and passenger trains, operating between Kansas City and Birmingham, we formerly required six locomotives, whereas today we use only one. This has permitted us to reduce the number of locomotives required materially, building up the mileage on those that are in use. As a result it has been possible to set aside the smaller power which is entirely inadequate to handle the long trains now being operated over the railroad. It was thoroughly demonstrated during the past year

time and this is due to the condition of our power.

"One of the most outstanding facts in connection with our power condition is the treatment of water used in the locomotive boilers. The boiler condition is one of the prime factors in keeping engines on the road. * * * * To give you briefly what the treatment of water has done to keep our power in service, in 1918 we had 575 leaking boiler failures; in 1923 we had 90, and in 1928, one, while in 1929 we did not have any failures chargeable to leaking boilers. Furthermore, we were required



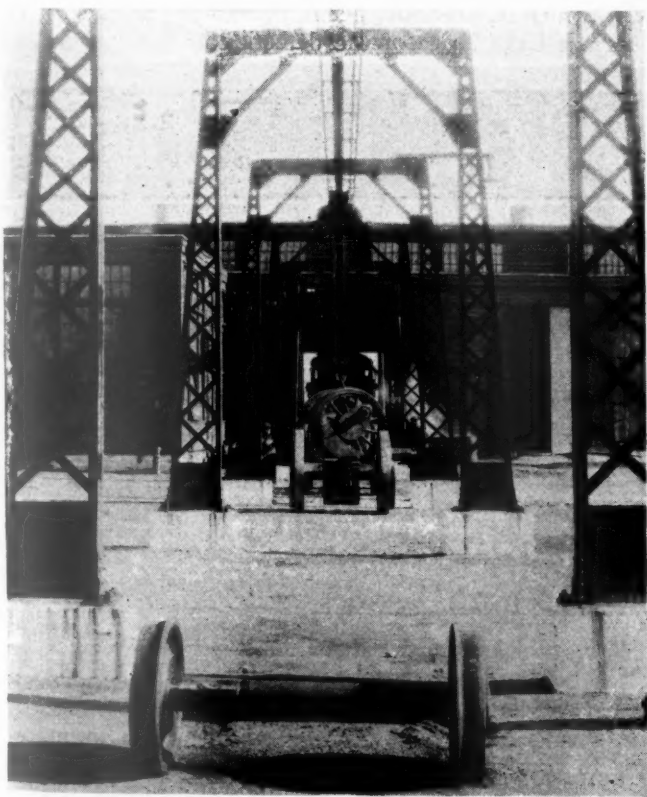
Lo-Hed 16,000-lb. electric hoist raising a pair of driving wheels

after every 30,000 to 50,000 miles to stop our power for flues, while we are today, on passenger engines, getting 200,000 miles. All other classes have likewise done proportionately as well."

Yale Enginehouse Devices

The 24-stall enginehouse of the St. Louis-San Francisco, constructed at the Yale (Tenn.) terminal approximately two years ago, is equipped with a mono-rail hoist which proves most helpful in carrying on locomotive conditioning operations at the terminal. This hoist, known as the Lo-Hed Class B and H electric hoist, manufactured by the American Engineering Company, Philadelphia, is electrically operated and has a capacity of 16,000 lb. By means of a suitable mono-rail and trolley arrangement, this hoist operates from the blacksmith shop and flue-rattling machine through the machine shop to the enginehouse and thence, by means of suitable rail switches, to the individual enginehouse tracks. This hoist proves particularly effective in handling such heavy material as driving wheels, large castings, loaded flue racks, sets of superheated units, etc. Boiler front rings, smoke stacks, cabs, etc., are readily removed or applied with its aid. Driving wheels and engine truck or tender wheels are lifted from the drop pit and moved to the machine shop with a single handling. Entire sets of main and side rods can also be handled at one trip to the machine shop or the lye vat.

Experience indicates that this mono-rail hoist requires



Mono-rail hoist connecting shop building and enginehouse

with Locomotive 4113, which made five complete round trips between Kansas City, Mo., and Birmingham, Ala., a total of 7,350 miles, without knocking the fires, that it is far more economical to maintain power and equipment in 100-per cent condition than it is to pass up necessary repairs. We are today getting more mileage per day out of our locomotives than at any previous

little maintenance and that, on the infrequent occasions when it has been out of commission, enginehouse operations were greatly handicapped. The rail switches in the enginehouse are thrown by a cable extension to the floor. The hoist is also operated longitudinally and the



View in enginehouse showing mono-rail connections to individual pits

lifting hook is moved up and down by means of similar cable extensions. A safety device holds the load should the power be cut off from any cause. Rigid instructions



Convenient dump truck used at Frisco enginehouse, Yale, Tenn.

are also issued in the interest of safety to have the power shut off whenever any work is being done on the hoist; moreover, men are not permitted to walk or

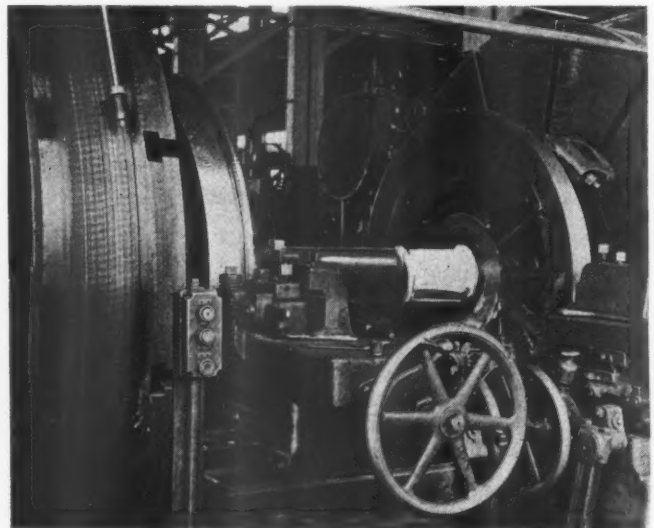
work under the hoist when it is carrying a load. The ends of the mono-rail system are amply blocked to prevent the hoist running off, and experience shows that it cannot leave the rail at the switches even if the latter are not exactly in alignment with the rail over which it is desired to have the hoist pass. With reasonable care, however, the switches will always be aligned correctly either with the main circle track or the individual pit tracks.

Dump Truck Used at the Yale Terminal

A convenient dump truck used at the Yale terminal is also shown in one of the illustrations. This truck, made of sheet metal mounted in a channel iron frame, is equipped with pressed steel wheels to operate on standard gage track. Suitable handles are provided for readily pushing the truck where desired about the enginehouse. The truck is fitted with a sliding dump door on the bottom, moved by a handle applied to the squared end of the operating shaft on the right end of the car. This car proves a big help in cleaning up about the enginehouse and saving labor in handling ashes and similar material which may require being dumped in the cinder pit.

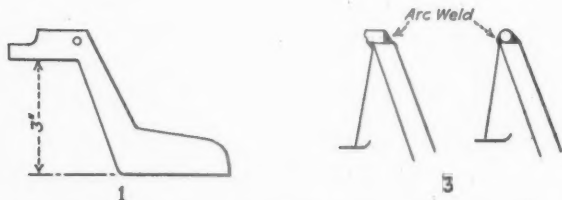
Detecting Cracked Axles

THE accompanying illustration shows a method which has recently been put into use on the Pittsburgh & Lake Erie for the detection of cracked axles.



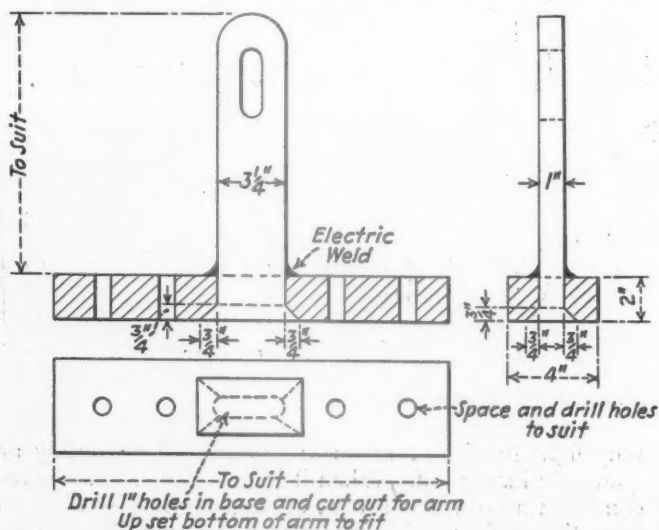
The journal whitewashed for the detection of cracks

The wheel-lathe operator whitewashes the journals of the driving axle after he has set up the wheels preparatory to restoring the tires to standard contour. After the whitewash has dried the operator inspects the journals for cracks which will show in the whitewash due to the chattering of the machine caused by the extremely heavy cuts taken with this type of machine. No waste of time or labor is required by this practice, as the whitewashing and inspection can be accomplished while the machine is in operation and the operator is otherwise idle. This practice has recently resulted in the detection of several cracked axles which otherwise would have been placed back in service, probably resulting in locomotive failures or wrecks.



made the cutting of the tank from the engine for the removal of the conveyor screws unnecessary.

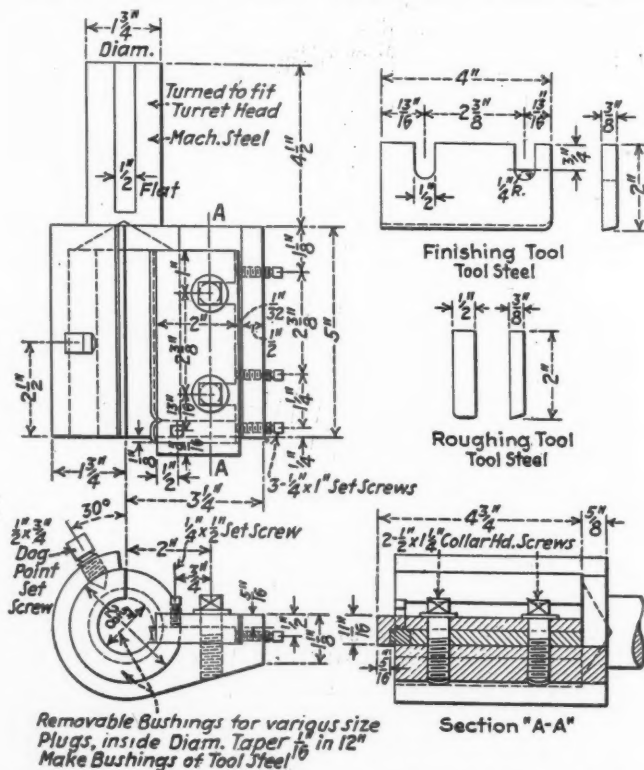
THE two-piece spring-equalizer stand shown in the drawing was designed to overcome an excessive amount of breakage of the solid forged type, the arm of which broke off near the base of the stand. An epi-



demic of failures of this kind on the road where the stand herein described was designed caused considerable trouble, especially to the machinists and blacksmiths located in the smaller shops where no adequate equipment was located for forging such stands in case none were otherwise available. Considerable experimenting resulted in the two-piece stand being adopted and with its use the breakages have been reduced to one over a period of three years, the one being attributable to material flaws.

forged out separately. The base is drilled and then slotted, either by burning with an acetylene torch or by chipping. The bottom of the arm is heated, upset and swelled to fit into the base of the stand, and welded for the purpose of holding the parts together until the stand is put into use. The effectiveness with which this stand has served its purpose is due to its flexibility, the strain at the intersection of the base and the arm being relieved to such an extent that breakage from this cause has been entirely eliminated.

SHOWN in the drawing is a tool especially adapted for use on Fox lathes and which is designed to facilitate the machining of driving-box plugs by relieving the operator of the necessity of adjusting the taper attachment of his machine. The device, held by the turret head, is designed to accommodate bushings of various sizes, the inside diameter and taper of which are the same as the finished plugs. The bushings, held in place



by a $\frac{1}{2}$ -in. by $\frac{3}{4}$ -in. dog-point set screw, steady the plugs as they are being turned by the roughing and finishing tools. The roughing tool, 2 in. long, $\frac{1}{2}$ in. wide and $\frac{3}{8}$ -in. thick, is held securely in the tool post by $\frac{1}{4}$ -in. by $\frac{1}{2}$ -in. and $\frac{1}{4}$ -in. by 1-in. set screws. The finishing tool, the length and taper of which are the same as the finished plug, is held in place by two $\frac{1}{2}$ -in. by $1\frac{1}{4}$ -in. collar-head and two $\frac{1}{4}$ -in. by 1-in. plain set screws. The depth of cut desired is regulated by the $\frac{1}{4}$ -in. by 1-in. set screws which also prevent the tools from moving while the cut is being made. When the brass stick from which the plugs are to be made are chucked in the machine, the roughing tool cuts it to appropriate size and as it continues down the depth of the bushing the long finishing tool finishes it to the correct size and taper.

NEW DEVICES

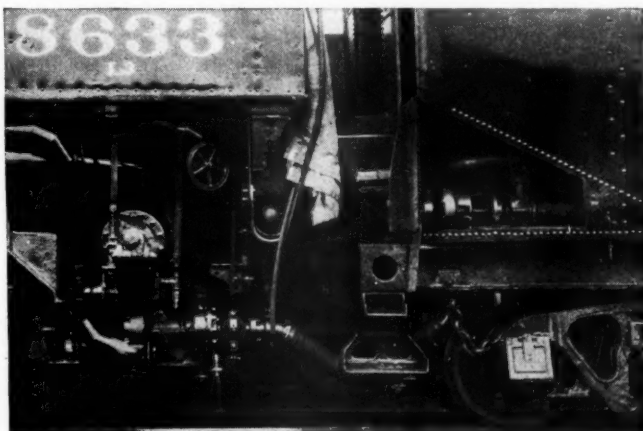
The Locomotive Water Conditioner

IN the illustrations is shown a device designated by the builders as the Locomotive Water Conditioner which is designed jointly to preheat feedwater to the atmospheric boiling point and to settle out free mud and hardness impurities before the water is delivered to the boiler. The device, built by the Bird-Archer Company, Chicago, Ill., combines the principal features and necessary apparatus of the chemical feedwater plant and the feedwater heater, installing the former as well as the latter on the locomotive and placing them under the jurisdiction of those responsible for locomotive performance.

The device has been in operation for approximately one year on the Chicago, Milwaukee, St. Paul & Pacific. It has proved successful and the equipment involved is said to have cost less and to be less complicated than that required for either the treatment of water or for the preheating of feedwater, taken singly. It is anticipated that the equipment ultimately required for the combination of these two functions may be installed for approximately \$2,500 per locomotive. The device has been operated without extra labor costs other than ordinary maintenance and the cost of the chemicals required for the treatment of the water evaporated, the cost of the latter being five cents per 1,000 gal. Owing to the fact that the water is treated on the tender, there is no waste of chemicals through the diversion of treated water from wayside tanks.

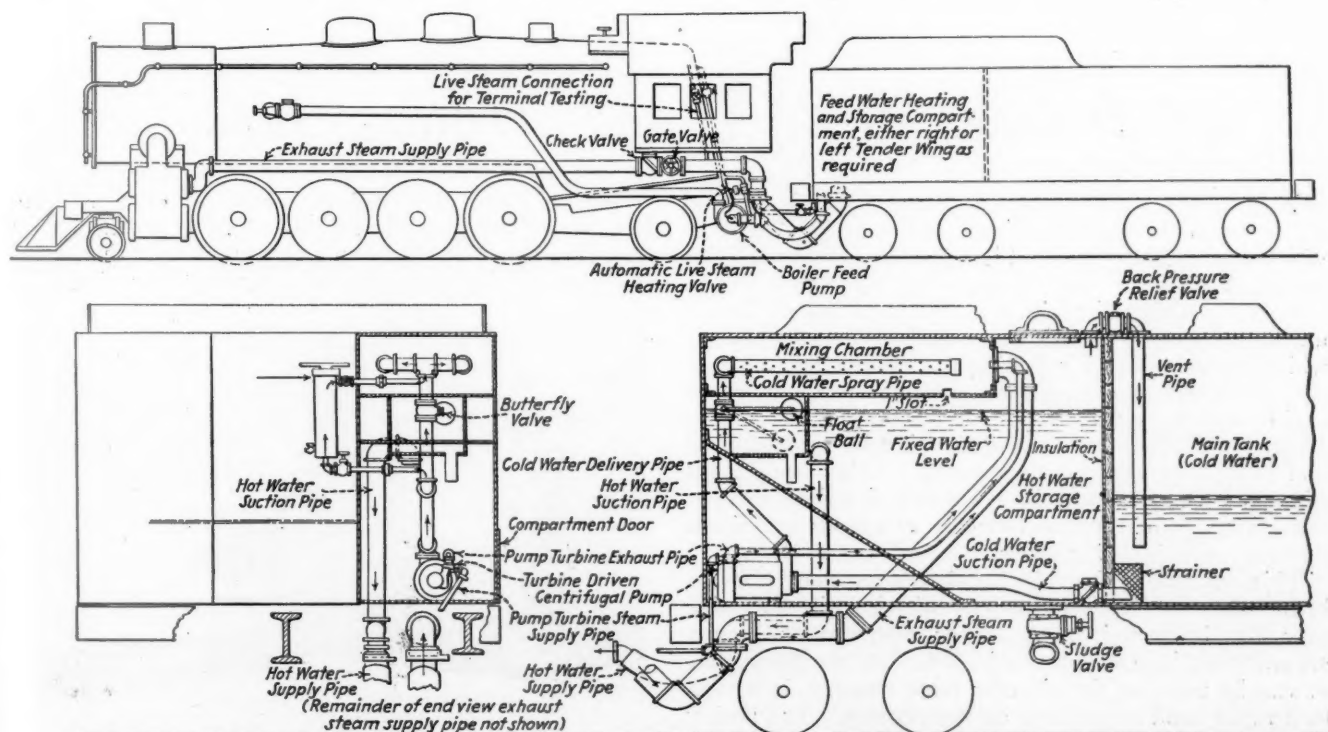
As seen from the diagrammatic sketch of the appa-

ratus, the left water leg of the tank is partitioned off from the rest of the tender so as to provide a hot-water storage tank and mixing chamber for the cold water supply and the exhaust steam. Water is taken from the main tank through a strainer and lifted by a centrifugal pump mounted on the tender to the mixing



The boiler feed pump and cold water pump arrangement

chamber where it is sprayed through two perforated pipes. Exhaust steam from the cylinders and auxiliaries passes through an oil separator and is automatically fed back through combining tubes to the mixing chamber until the temperature in the heater compartment has reached the atmospheric boiling point, at which point a back pressure develops, preventing the access of additional steam. The heated water and surplus steam passes through the bottom plate of the mixing chamber, which is slotted, the



The piping arrangement and the details of the feedwater heater and water conditioning apparatus

water filling the storage tank to a predetermined level that is controlled by a butterfly float valve in the cold water delivery line. The surplus steam is condensed after passing through a vent pipe into the main tank, as shown in the drawing.

The water for the boiler feed pump is taken from a point considerably below the surface of the hot water in the storage compartment, thus allowing a reserve supply of hot water to be used at such times as the main engine may not be working, and preventing the use of cold water at all times.

A boiler feed pump, located under the locomotive deck, is arranged, by automatic control, to operate only when the water has been heated to a predetermined temperature.

The chemical treating apparatus is also located on the

left water leg of the tank, at the coal gate. It consists of a cylindrical container fitted with a cap and is connected to the cold water delivery pipe as shown in the drawing. This container is filled with briquettes of necessary chemical composition which are dissolved by the passage of the water through the container and carried into the mixing chamber. The cold water, under the control of the float valve and carrying the required chemical solution, is sprayed in contact with the steam in the manner described above. The chemical reaction takes place as the water is heated, resulting in many of the hard, scale-forming impurities being settled out in the storage tank before being delivered to the boiler. These hardness impurities, together with free mud, are deposited in the bottom of the storage tank and are discharged at engine terminals at the end of each run.

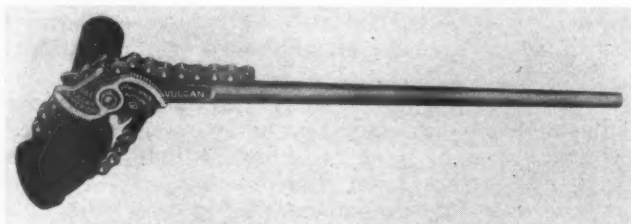
The Vulcan Pipe and Fitting Tongs

THE Vulcan Superior chain tongs for universal service on both pipe and pipe fittings have recently been introduced as an additional product of J. H. Williams & Co., Buffalo, N. Y. The tongs are provided with a vee-recess in the jaws to assure a quick and positive grip on fittings, thus incorporating in ordinary pipe tongs a feature which makes is unnecessary to use two tools for pipe work, one for pipe and one for

pipe fittings. These tongs are equipped with reversible



The tongs showing the vee recess for gripping pipe fittings



The Vulcan Superior tongs equipped with a flat chain

pipe and fitting jaws which are simply turned end for end when the teeth first in use are worn out. The chains, either the flat or cable type, lock easily and positively. Each flat chain is proof-tested and certified, assuring safety to the operator.

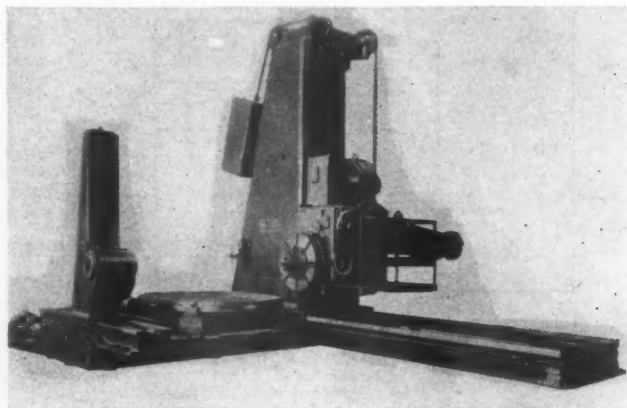
A Boring, Drilling and Milling Machine

IN the illustration is shown a Betts 7-in. horizontal boring, drilling and milling machine of the floor type which has recently been added to the line of the Consolidated Machine Tool Corporation, Rochester, N. Y.

This machine, built with spindle diameters of 5½ in. up, has a variable-speed motor mounted on the saddle which is used solely for driving the spindle. A separate variable-speed motor provides milling feed and power rapid traverse for the saddle and column, and another motor is provided for moving the circular table toward and away from the column runway. This arrangement of separate motors for the column and saddle and for the spindle provides a wide range of speeds and feeds without complicated gearing.

This machine is furnished with a large floor plate of heavy box construction but, if required, a circular table may also be supplied. A steady rest, mounted on a separate carriage which can be bolted to the floor plate or can be used on the circular table runway, is moved by a rapid hand adjustment on the runway. The boring bar bearing has a vertical hand adjustment on the column.

The spindle of this machine is made from high-carbon hammered steel and is supported in a bronze-bushed cast-iron sleeve. The column is provided with a graduated scale for accurate adjustment, taper shoes for



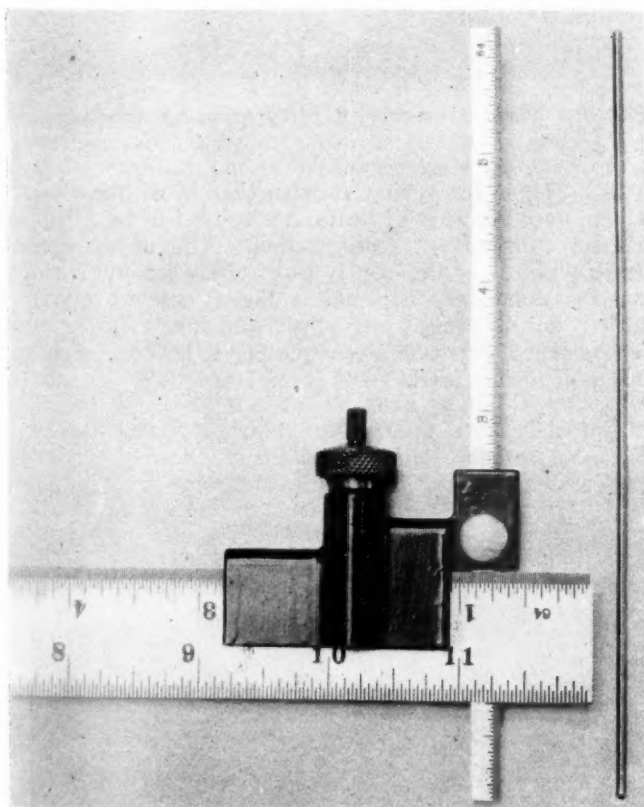
The Betts 7-in. horizontal boring, drilling and milling machine

taking up wear, and with standard Betts-narrow guide for the saddle. The motor for milling feed and power travel of the column and the saddle is located on a shelf at the base of the column. The saddle, which has a large bearing surface on the column, has a vertical travel of 10 in. and is provided with a platform, for the operator, which facilitates the operation of the various controls.

The Farval one-shot centralized lubricating system is provided, insuring an ample supply of lubricant to every vital part of the machine. For boring and drilling this machine has eight feeds and is capable of cutting threads of four different leads. For milling, a wide range of speeds is obtainable through the variable-speed motor and the supplementary mechanical changes which have been incorporated in the design.

A Combination-Square Depth-Gage Attachment

THE Brown & Sharpe Manufacturing Company, Providence, R. I., announces the No. 468 depth gage attachment for a combination square or set as an



A combination square set with the B. & S. No. 468 depth-gage attachment

addition to its line of tools. This attachment measures directly from the lower edge of the blade of the square and is easily read. It is a particularly useful tool for measuring the depth of wide recesses.

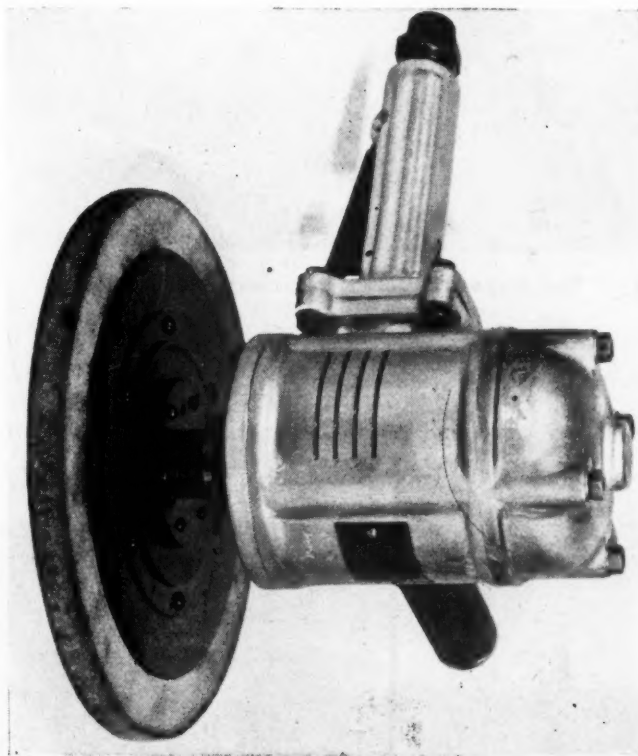
An English measure attachment has a range of 0 in. to 4½ in. with 6-in. blade, graduated in thirty-seconds

and sixty-fourths, or sixty-fourths and one hundredths. A blade with thirty-second and sixty-fourth graduations is furnished unless otherwise specified. The attachment is also furnished with metric measure which has a range from 0 to 114 millimeters with a 15 centimeter blade graduated in millimeters and half-millimeters. A rod 5/64 in. in diameter is furnished for use in small holes. This depth gage attachment may be used on 9-in., 12-in., 18-in. and 24-in. Brown & Sharpe combination squares and sets. It cannot be used on combination squares and sets which are provided with heavy blades.

Hercules Portable Sander and Grinder

THE Buckeye Portable Tool Company, Dayton, Ohio, has developed a new pneumatic sander and grinder, the No. 362-4, for use with felt pads and abrasive discs or with cup wheels.

The new tool is equipped with the Hercules governor,



The Hercules No. 362-4 pneumatic grinder

which gives a higher speed under load, less air and more power. The air in this tool does not pass through the governor but is delivered directly to the rotor.

The grinder is equipped with the Hercules safety throttle, the dead-air handle on this model now containing an oil reservoir. This dead-air handle is tapered to hammer-handle shape and fits the operator's hand snugly.

Both handles are placed close to the center of the tool for maximum grinding pressure without over-balancing the tool.

A Rotating and Reclining Day-Coach Seat

IN the illustration is shown a rotating and reclining day-coach seat which can be faced in any desired direction, thus permitting coach passengers to face the windows for full enjoyment of the scenery along a rail route. This coach seat is designated as the 155 PSS by the manufacturers, the Heywood-Wakefield Company, 209 Washington street, Boston, Mass. The chair rotates on a small radius and is so designed that it can be placed with the armrest flush with the side wall.



The Heywood-Wakefield rotating and reclining day-coach seat

In addition to its rotating features the seat is equipped with individual backs which can be reclined separately to four restful positions by means of levers located at

the side of the chair. The same levers return the backs to their original position easily and quickly by means of a spring arrangement.

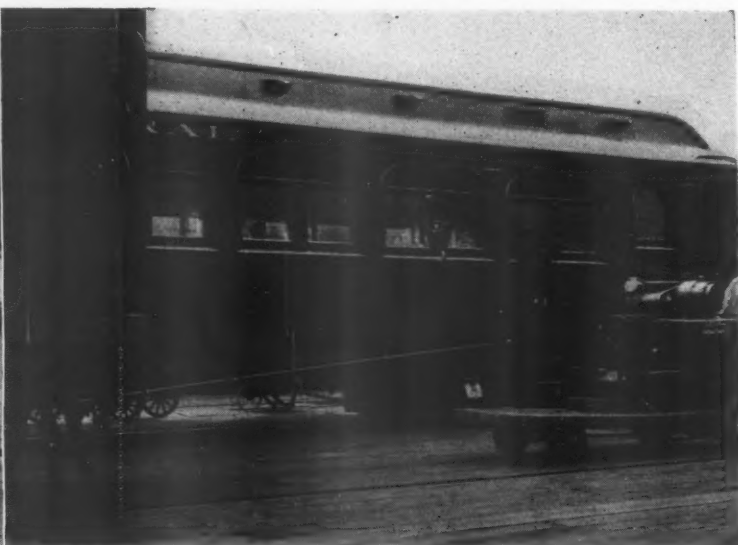
The cushion construction is of the double-deck bucket



The seat offers a number of party grouping arrangements

type. The lower spring construction is of the design which, over a period of years, has proved to be substantial for railroad seat construction. The upper spring construction is of the Comfy type. Between the springs and the upholstery material, a high grade of genuine curled hair is used. The upper and lower spring sets are fastened permanently together, a bellows type of fastening being used.

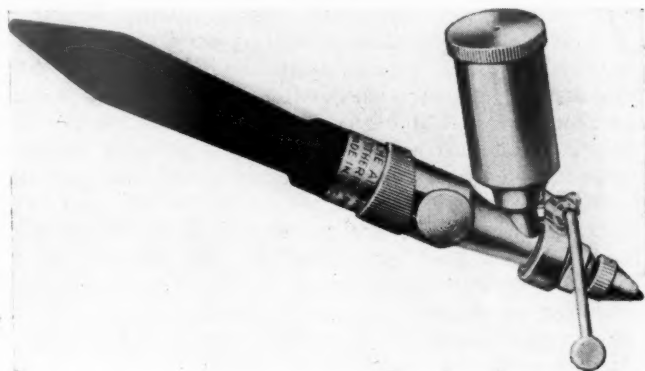
* * *



Moving a car with a car mover to spot it over a pit is slow work, but spotting a car with an electric truck is a simple matter and is quickly accomplished

The Paasche Universal Striper

A FOOLPROOF mechanical tool for painting continuous stripes in a vertical or a horizontal position has recently been added to the line of products manufactured by the Paasche Airbrush Company, 1909 Diversey Parkway, Chicago, Ill. This tool, designated as the Universal striper, is equipped with an adjustable line tip ranging from 1/32 in. to 3/32 in. in width, an adjustable regulating sleeve which gives quick and accurate control of color feed and a revolving and adjustable guide. The color cups are detachable so that an

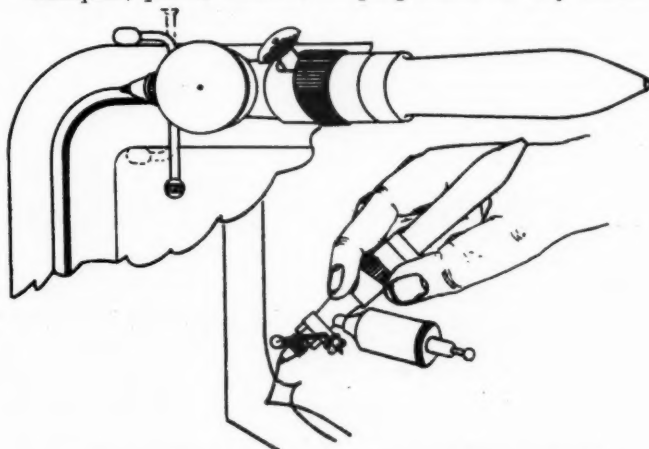


The Paasche Universal striper

extra pressure color cup may be attached for striping overhead or underneath when it is necessary to force fluid upward to the slotted tip or when heavy colors are used for obtaining a raised or embossed stripe, scroll or decoration. The pressure cup has a screw cover with

a plunger operated by a spring which continually feeds the color under pressure.

Lacquer, paint, enamel, striping fluids or any finish-



Graceful lines, stripes and curves are easily painted with the Universal striper

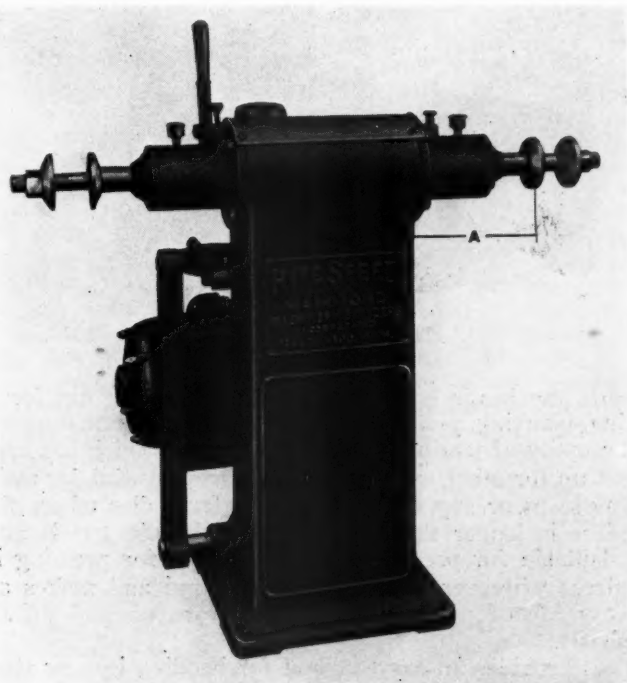
ing material in one or more colors which appear as in-laid work will wear as long as the finished surface that it becomes a part of, due to the uniform and even flow of the color which is regulated by the striper to feed as fast or as slowly as the work requires. The painting of graceful lines, artistic stripes, curves and circles, work sometimes left undone for the lack of skilled stripers, can be done with the greatest of ease by the use of the Universal striper in the hands of anyone without striping experience or skill.

The Rite-Speed Polisher and Buffer

THE Hammond Machinery Builders, Kalamazoo, Mich., have placed on the market a polisher and buffer which they have designed as the Type C Rite-Speed electric polishing and buffing lathe. The machine is not equipped with auxiliary speed-control apparatus. The correct speeds for either polishing or buffing, which are usually 2,000 to 2,400 and 2,400 to 3,000 r.p.m., respectively, are secured by merely changing a pulley on the motor. Power is transmitted from the motor to the spindle by means of the multi-V belt drive, which is silent and non-slipping.

A unique method of mounting the motor on the rear of the pedestal results in a minimum amount of floor space being occupied by the machine, without sacrificing clearance around the spindle. With this method of mounting the motor, belt-tension adjustment is made by a single adjusting nut without disturbing the motor mounting. The motor is totally enclosed, fitted with a motor air cleaner which discharges dirt and dust before it enters the motor windings.

An additional feature of this machine is the ease with which belts can be changed. By removing the four large cap screws on each side of the spindle, the entire spindle can be removed from the pedestal without disturbing the bearing mounting or sub-assembly parts. The motor adjustment screw is then loosened, thereby taking the tension off of the motor pulley, and the belt slips off of the spindle.



The Hammond Rite-Speed polishing and buffing lathe

The combination switch and brake is a new feature on all Hammond Rite-Speed polishing machines. With this design, it is only necessary that the operator pull the lever forward to break the current connection and apply the brake. The brake is released and the motor started by reversing this operation.

Timken tapered rollers or ball bearings, automatic motor starter, flat-top threads and spindle lock are all standard equipment on this machine, which can be supplied with any standard motor specifications in a complete range of sizes from 3 to 15 hp. capacity.

The Simplex Utility Press

IN the illustration is shown the Simplex utility press which is a recent product of the Simplex Tool Company of Woonsocket, R. I. This press, particularly designed for use in the tool room and machine shop, has a varied number of uses. It may be used for shearing



The Simplex utility press

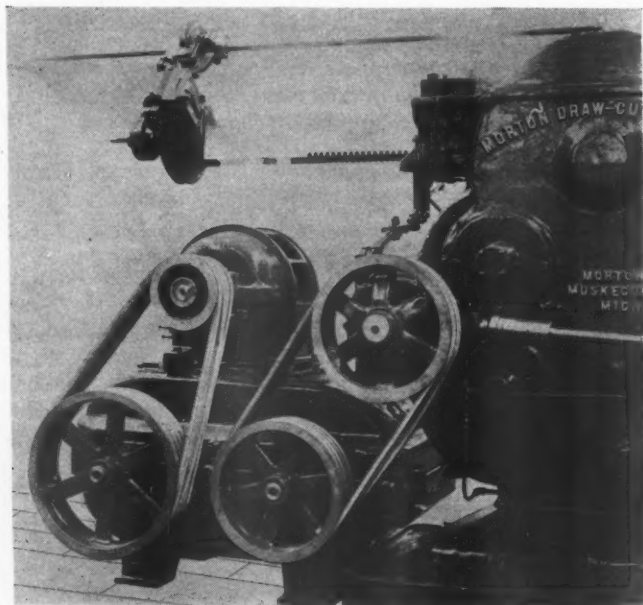
soft punches in hardened dies and for trying out forming, blanking, piercing and bending dies, eliminating the necessity of tearing down a punch press which has been set up for other work. It is also found useful for making stops or supports that extend from dies where the piece is longer than the width of the die. It is also adaptable for pressing posts in dies or for pressing in pieces wherever a press fit is required and makes an easy job of pressing pulleys or gears on and off of shafts.

It provides an easy method for bending iron or steel up to 1/2 in. by 4 in. to a 90 deg. angle, doing it in considerably less time than it would take to heat a piece in

the forge. Brackets of all kinds, machine supports, braces, tie-pieces, etc., are easily fabricated. The press develops sufficient pressure to straighten a shaft 3 in. in diameter and, with the angle nose and V-blocks in place, it is ideal for straightening shafting or bars of all kinds, pipe, tubing, or pieces warped in hardening.

A Variable Speed Transmission Unit

THE Morton Manufacturing Company, Muskegon Heights, Mich., has recently placed on the market a variable speed transmission which has an unlimited number of speed changes and which is especially adapted to Morton high-duty draw-cut shapers. The unit is quiet and powerful and it is possible to get a three-to-one speed range. All the speed changes may be made while the machine is in motion and any changes desired are accomplished by means of a hand wheel within easy reach of the operator at all times. The cutting speed or cutting feet per minute is shown on a speed indicator within constant view of the operator and it is possible to make all speed changes while the machine is in motion. If it is desired, the operator of the machine can change the cutting speed by inches. A Reeves drive unit is used as



The variable speed transmission unit attached to a draw-cut shaper

a part of this transmission and although it is especially adapted to Morton draw-cut shapers it is so designed that it can be applied to other motor-driven machine tools.

With 35,000,000 guests a year, the Pullman company is the most extensive hotel keeper in the world. From a modest and precarious beginning 60 or more years ago, under the supervision of George M. Pullman, the Pullman company now handles more than 100,000 travelers a day. This is a yearly total equaling nearly one-third of the country's total population, the company's passengers traveling in a year a total of 13,600,000 miles.

Among the Clubs and Associations

CANADIAN RAILWAY CLUB.—“As a Judge Sees It” is the title of the paper to be presented by Hon. Judge Monet before the meeting of the Canadian Railway Club on March 10 at 8 p.m. at the Windsor Hotel, Montreal.

CAR FOREMEN'S ASSOCIATION OF CHICAGO.—The new A. R. A. rules will be discussed at the meeting of the Car Foremen's Association of Chicago at 8 p.m. on March 10 at the Great Northern Hotel, Chicago.

RAILWAY CLUB OF GREENVILLE.—W. C. Hawes of the car service department of the Bessemer & Lake Erie will be in charge of the meeting of the Railway Club of Greenville to be held on March 18 at 6:15 p.m. at the Zion's Reformed Church, Greenville, Pa.

PACIFIC RAILWAY CLUB.—The thirteenth annual meeting and banquet of the Pacific Railway Club will be held on March 13 at 6:30 p.m. at the Elks Club, San Francisco, Cal. The principal speaker will be Alfred J. Lundberg, president, Key System Transit Company. Presidents of local railroads will be among the other speakers.

NEW ENGLAND RAILROAD CLUB.—The annual meeting of the New England Railroad Club will be held on March 11 at 6:30 p.m. at the Copley-Plaza Hotel. Following the election of officers an address will be given by Albert Kennedy Rowswell, reader, humorist-philosopher from Pittsburgh, Pa.

THE PURCHASES AND STORES DIVISION of the American Railway Association, W. Davidson, chairman; W. J. Farrell, secretary, has issued circular No. 220, announcing the eleventh annual meeting of the division, to be held at Atlantic City, N. J., June 18, 19 and 20, 1930. The sessions will be held in the meeting hall of the new Municipal Auditorium, beginning at 9 a.m., Wednesday, June 18. In addition to the reports of the standing committees, there will be reports by special committees on twenty-three subjects of interest to members of the Purchases and Stores Division.

WESTERN RAILWAY CLUB.—George H. Houston, president of the Baldwin Locomotive Works, will be the speaker at the March 17 meeting of the Western Railway Club which is to be held at 6:30 p.m. at the Hotel Sherman, Chicago. Music and vaudeville entertainment will be provided.

EASTERN CAR FOREMEN'S ASSOCIATION.—At 8 p.m. on March 28 at the Engi-

neering Societies building, Room 502, 29 West Thirty-Ninth street, New York, the Eastern Car Foremen's Association will be addressed by William H. Tucker of the Vapor Car Heating Company on the heating of long trains—shop practice, yard maintenance and inspection of heating apparatus.

AMERICAN SOCIETY FOR TESTING MATERIALS.—On March 19 at 6:30 p.m., following a technical program devoted entirely to the automotive industry, the American Society for Testing Materials will hold a regional dinner at the Book-Cadillac Hotel, Detroit, Mich., during which a number of novel and striking demonstrations utilizing photo electric phenomena will be presented through the courtesy of the General Electric Company.

Club Papers

Discuss the New Rules

Chicago Car Foremen's Association.—Meeting held at the Great Northern hotel, Chicago, on February 10. Like the January meeting, this meeting was devoted to a discussion of the new A. R. A. rules of interchange. The meeting was presided over by President F. J. Swanson, district master car builder of the Chicago, Milwaukee, St. Paul & Pacific, Minneapolis, Minn.

Human Factors in Transportation

Railway Club of Pittsburgh.—Meeting held at the Fort Pitt Hotel, Pittsburgh, Pa., on February 27, 1930. Address by G. K. Roper, senior secretary of the transportation department of the National Council of Y.M.C.A.'s of the United States. ¶ Mr. Roper spoke on the increasing value of the proper training of the younger men employed on the railroads of this country. He talked in a most interesting manner of the work that is being done with these younger men to assure that they receive the attention necessary to fit them for future responsible positions in railroad organizations. A part of Mr. Roper's address was devoted to a discussion of the requisite qualities of leadership railroad work and he said that, aside from the ability to direct work, a man, to be a leader, must have the personality and character which inspires confidence in those whom he must supervise. ¶ In concluding his remarks he told of the broad scope of the work of the Railroad Y. M. C. A. and spoke at some length on the several Younger Men's Conferences which have been held within the past few years by means of which some

3,500 young men from many railroads throughout the country have had an opportunity to avail themselves of a three-day period of intensive vocational guidance and training.

A Good Year Ahead

St. Louis Railway Club.—Meeting held at the Hotel Statler, St. Louis, Mo., January 10. Address on “The Future of the Railroads,” by M. J. Gormley, executive vice-president, American Railway Association, Washington, D. C. ¶ After outlining the service which American railroads are now performing and commenting on the competition which they must meet from the highways, inland waterways and the air, Mr. Gormley closed his remarks as follows: “The railroads today don't have to take a back seat for any industry in the United States so far as progress is concerned. There has been a greater forward progress in the railroads in the last six years than in any other industry in the United States. They will be perfectly able to hold their own with any kind of transportation if they are given a fair and a square deal. We don't have to worry about their future at all. Railroads are always going to be the backbone of transportation in this country. They are going to spend about a billion and fifty million dollars in 1930 for improvements, having pledged themselves to do so in accordance with President Hoover's program. If that is all carried out, I think we are going to finish 1930 with a surprisingly good year, in spite of any pessimism that may exist at the present time.”

Recommended Air-Brake Practice

Manhattan Air Brake Club.—Meeting held 150 Broadway, New York, Friday, February 21, 1930. ¶ Announcement of the death of Frank W. Nagle, mechanical expert, Westinghouse Air Brake Company at Philadelphia, Pa., was made at the opening of the meeting of the Manhattan Air Brake Club, February 21, 1930. Many fine tributes were paid by those present to Mr. Nagle, who had represented the company at Philadelphia for nearly 25 years and was well known in the air brake field. ¶ During the technical session the members of the club discussed the question of whether or not a standard retaining-valve test code would serve a useful purpose in air-brake maintenance. A number of roads have formulated retaining-valve test specifications of their own. Also a number of roads deem it desirable to remove the retaining valve from the car when the triple valve is tested. A proposed test code for retaining valves was exhibited and discussed at the meeting. Another subject included in

the list of topics was the boring, grinding and bushing of the cylinders of motor-driven air compressors used on motor-rail cars. ¶ The feature of the meeting was the discussion of a number of proposed changes to the recommended practice of the Air Brake Association which have been suggested by the Pittsburgh Air Brake Club.

Changes in Interchange Rules

Eastern Car Foreman's Association.—Meeting held at the Engineering Societies building, 25 West Thirty-ninth street, New York, on January 24, 1930. Paper by Livingston Martin, chief of the car-repair accounting bureau, Baltimore & Ohio, Baltimore, Md. ¶ Mr. Martin in his paper discussed the A.R.A. rules and changes and in his discussion he expressed the hope that those present at the meeting would leave with a uniform understanding of the rules so that they could be applied correctly. He began his discussion with Rule 1, and took up each rule consecutively, making appropriate comments on each rule and respective interpretations as published in the Interchange Rules. It was his experience, he said, that Rule 4 was the most generally misunderstood rule in the Interchange Code. It was his opinion that with the elimination of the words "before reloading car" from Rule 4, the owners could demand a defect card for any damages except those listed in the rule. ¶ Rules 4 and 87 are the rules by which defects cards must be issued for handling—line defects and wrong repairs. Knowing some of the efforts that have been made since the penalty was placed in Rule 87, he said, he was of the opinion that a similar penalty for the non-issuance of defect cards would have beneficial results. ¶ In conclusion he reminded his audience that the fundamental principle of the Interchange rules is the same as it has always been; namely, honesty. Along with this he pointed out, if we will endeavor to apply the principle of the golden rule the labors of the Arbitration Committee will be considerably lessened, the cost of handling car-repair bills reduced and a better feeling will exist between the billing departments of the railroads.

Railroad Electrification in Prospect

New York Railroad Club.—Meeting held at New York, February 21. Paper by F. H. Shepard, director of heavy traction, Westinghouse Electric & Manufacturing Company.

This was electrical night at the New York Railroad Club and, in addition to Mr. Shepard's paper, a number of interesting electron-tube phenomena were demonstrated in a lecture by S. M. Kintner, manager of the Westinghouse research engineering department. In his paper Mr. Shepard reviewed the development and growth of heavy electric traction in America as a background against which to deal with future developments. In comparing electricity with steam motive power, he said: "Of one thing we are certain—the United States has grown and developed through rail transportation, and the growth of population and industry in

the United States will continue to develop a demand for increased rail transportation. This will be between and to our industrial and populous centers. Existing lines will at the same time be called upon to carry double the existing volume of traffic and, in the not distant future, a still further increase. Our great distances, coupled with the progressive increase in the scale of living, which are largely the reasons for the present 4,000 ton-miles per capita compared with some 10 or 20 per cent of this in other industrialized nations, would seem definitely to assure this conclusion. **** ¶ Electrification of the future will, therefore, be with equipment to secure a vast increase in capacity and in speed of movement. In considering the relative cost and advantage of services, the consumption of power becomes distinctly minor as a factor. Who thinks today of the relative power required for good or better illumination, or for good or better subway operation, or for good or better machine tool output?" ¶ Mr. Shepard concluded with a description of the electric locomotive equipment which is being developed for use on the Pennsylvania electrified main line now projected. Passenger units will have two and three driving axles, the units to be coupled as required. The continuous rating will be 1,400 hp. per axle, capable of being sustained at speeds up to and exceeding 90 miles per hour. A maximum of 2,000 hp. can be developed for short periods of time. The freight units will have four drawing axles, the number of units forming a locomotive being dependent on the strength of car equipment. Each freight axle will develop 700 hp. continuous rating and a three-unit locomotive will aggregate 8,400 hp., continuous rating, and will be capable of developing 12,000 hp. for short periods.

What the Car Man Does

Western Railway Club.—Meeting held at the Hotel Sherman, Chicago, February 17. Address by W. E. Dunham, superintendent car department, Chicago & North Western, Chicago. ¶ In discussing what a car man does, Mr. Dunham said that he is a composite inspector, repair man, shop man, cabinet maker, car designer and engineer. The car man's primary responsibility is to furnish cars for any kind of loading, which means the right car in the right place and in the proper condition for loading. Mr. Dunham emphasized particularly the need of always being one step ahead of the shipper in foreseeing what type of cars will be required and thus anticipating the demand. ¶ Far more expert knowledge of car details and operating conditions are required of car men today than formerly, according to Mr. Dunham. Some of the best car inspectors possibly still write and read with some difficulty, but the general average of knowledge and experience with the interchange rules, loading rules and many other things which the car inspector must know is relatively high. The old "wheeze" about the car inspector who didn't know why he was tapping the wheels has practically no basis in fact today. ¶ In commenting further on the

work of the car man, particularly as relates to passenger equipment, Mr. Dunham said that the modern car man must be a paint specialist, an interior decorator, a heating expert and a ventilating engineer. Above all, he must be an organizer, in order to secure the desired results in the way of efficient car department operation. ¶ Most of the discussion of Mr. Dunham's paper hinged about the proper method of inspecting so-called "main tracker" trains. A. J. Krueger, master car builder of the Nickel Plate, Cleveland, Ohio, led the discussion and described the specialized inspection method, outlined in an article beginning on page 4 of the January *Railway Mechanical Engineer*.

How Some Men Fool Their Wives

New York Society of Model Engineers.—The following report of the activities of the New York Society of Model Engineers was published in a recent issue of *The New Yorker*. For the information of those interested, this society has its headquarters in Room 327, Knickerbocker building, 79 Fifth Avenue, New York, and the secretary is Fred Grimke, whose mail address is 21 East Eighty-Seventh street, New York. ¶ "In 1925 four gentlemen, still interested in the mechanical toys of their youth, got together to play with miniature railroad locomotives they had made. They founded a society which, to justify their taking so much time off from business and family life, they gave a highly dignified title, The New York Society of Model Engineers. The group has grown to about 90 now, and includes men who make other things than railroad engines, and avows a lot of serious purposes, such as 'demonstrating the difference between so-called 'commercial models' and actual scale-built models.' This fools the gentlemen's wives into thinking the whole thing is pretty important. What it really comes down to, though, is playing with choo-choo trains and such. ¶ The society holds meetings once a month in a back room in the Engineers' Club, where they take up the rugs, move the chairs aside, and show off their models. The locomotive builders lay down tracks and demonstrate the prowess of their respective creations. Most of the engines are coal-fired, and steam along like big ones, throwing off sparks. These are considered much superior to electric locomotives. One member put in 3,000 hours making an electric locomotive, and the coal-and-steam men just turned up their noses at it. Conservative members believe in still-life models and stress the importance of making exact replicas in miniature of big engines, but the radical element likes models that have works in them and will throw off sparks. The society also holds an annual exhibition. This year's was held in a room on Broadway and, as usual, the engines were most conspicuous. Tracks ran all about the room and the members cheered and shouted over their locomotives and trains. ¶ Some startling, interesting models were displayed at the show. One locomotive, built to scale, and about the size of a fat dachshund, had about everything a big

locomotive has, and bore a sign saying it had pulled eight people.

Vincent Astor, who is a member of the society, had one of the largest and best models, but it didn't make the show, because workmen dropped it in loading it for shipment. Mr. Astor's locomotive is 18 in. high. He has a track for it on his estate on Long Island and makes it pull things and people. Once he made it tow a Ford. Another time he rode on top of it, in a cramped position, towing cars bearing a load of 1,000 lb. This time he was out for an endurance record. Fuel and water were handed him in buckets and pitchers as he rode around the tracks. The engine could have gone on indefinitely, apparently, but he had to give up after 45 min., because his knees got tired. ¶ Other prominent members of the society are H. O. Havemeyer, Jr., who has a B. & O. Mountain-type locomotive, and Joseph T. Lozier (locomotives, freight cars, ships, etc.). Most model builders are business-men. There is only one real engineer in the lot."

A Suggested Joint Interchange Yard at Buffalo

Central Railway Club.—Meeting at Buffalo, N. Y. Paper presented by A. F. Burke, trainmaster, Buffalo Creek. ¶ A discussion on the advisability of establishing a joint interchange yard at Buffalo, N. Y., as a means of economy, the operation of the yard to be participated in by eight or ten railroads, was the feature of the December meeting of the Central Railway Club at Buffalo. The subject was brought forward in a paper presented by A. F. Burke, trainmaster of the Buffalo Creek, and the marked saving which can be made by the use of car retarders appears to have been a chief element in his argument for the establishment of a single large yard to do work which is now scattered through 42 yards. ¶ Mr. Burke finds that in the Buffalo district—not including the Black Rock exchange with Canada—the average number of freight cars interchanged daily is 5,210, equal to 217 cars an hour. For the inspection of these cars, which is done at 42 different yards, 144 men are employed, making 1,152 man-hours daily; and the interchange clerks number 243, equal to 1,944 hours. The car inspectors attend to an average of 4.04 cars an hour and the clerks an average of less than three cars an hour. By centralizing the work, these men could accomplish very much more; inspectors working in pairs can inspect 60 cars an hour and a clerk can interchange 50 cars an hour. ¶ For a central yard of this kind, 36 inspectors would be sufficient, as compared with 144 now employed in the Buffalo district, and 24 clerks would take the place of the 243 now employed. There would be savings also in locomotive power, in yard crews and in supervisory staffs. Some of the present yards, used only for interchange, could be discontinued. ¶ Aside from the question of economy in interchange, which was the main theme of Mr. Burke's paper, he called attention to probable economies in weighing freight, in adjustment of loads, in transfers and in repairs.

Directory

The following list gives names of secretaries, dates of next or regular meetings and places of meeting of mechanical associations and railroad clubs.

AIR-BRAKE ASSOCIATION.—T. L. Burton, Room 5605 Grand Central Terminal building, New York. Next meeting, May 13 to 16, Hotel Stevens, Chicago.

AMERICAN RAILWAY ASSOCIATION.—DIVISION V.—MECHANICAL.—V. R. Hawthorne, 431 South Dearborn St., Chicago. Annual convention June 18-25, Atlantic City, N. J.

DIVISION V.—EQUIPMENT PAINTING SECTION.—V. R. Hawthorne, Chicago. Next meeting, Sept. 9-11, 1930, Congress Hotel, Chicago.

DIVISION VI.—PURCHASES AND STORES.—W. J. Farrell, 30 Vesey St. New York. Annual convention June, 1930, Atlantic City, N. J.

DIVISION I.—SAFETY SECTION.—J. C. Caviston, 30 Vesey street, New York.

DIVISION VIII.—CAR SERVICE DIVISION.—C. A. Buch, Seventeenth and H streets, Washington, D. C.

AMERICAN RAILWAY TOOL FOREMEN'S ASSOCIATION.—G. G. Macina, 11402 Calumet avenue, Chicago. Next meeting, September 10, 11 and 12, Hotel Sherman, Chicago.

AMERICAN SOCIETY OF MECHANICAL ENGINEERS.—Calvin W. Rice, 29 W. Thirty-ninth St., New York.

RAILROAD DIVISION.—Paul D. Mallay, chief engineer, transportation department, Johns-Manville Corporation, 292 Madison avenue, New York.

MACHINE SHOP PRACTICE DIVISION.—Carlos de Zafra, care of A. S. M. E., 29 West Thirty-ninth street, New York.

MATERIALS HANDLING DIVISION.—M. W. Potts, Alvey-Ferguson Company, 1440 Broadway, New York.

OIL AND GAS POWER DIVISION.—L. H. Morrison, associate editor, Power, 475 Tenth avenue, New York.

FUELS DIVISION.—A. D. Black, associate editor, Power, 475 Tenth avenue, New York.

AMERICAN SOCIETY FOR STEEL TREATING.—W. H. Eiseman, 7016 Euclid Ave., Cleveland, Ohio.

AMERICAN SOCIETY FOR TESTING MATERIALS.—C. L. Warwick, 1315 Spruce St., Philadelphia, Pa. Annual meeting Atlantic City, N. J., June 23-27.

AMERICAN WELDING SOCIETY.—Miss M. M. Kelly, 29 West Thirty-ninth street, New York.

ASSOCIATION OF RAILWAY ELECTRICAL ENGINEERS.—Joseph A. Andrucci, C. & N. W., Room 411, C. & N. W. Station, Chicago, Ill.

ASSOCIATION OF RAILWAY SUPPLY MEN.—J. W. Fogg, MacLean-Fogg Lock Nut Company, 2649 N. Kildar avenue, Chicago. Meets with International Railway General Foremen's Association.

BOILER MAKER'S SUPPLY MEN'S ASSOCIATION.—Frank C. Hasse, Oxweld Railroad Service Company, 230 N. Michigan avenue, Chicago. Meets with Master Boiler Makers' Association.

CANADIAN RAILWAY CLUB.—C. R. Crook, 129 Charon St., Montreal, Que. Regular meetings, second Tuesday in each month, except June, July and August, at Windsor Hotel, Montreal, Que.

CAR FOREMEN'S ASSOCIATION OF CHICAGO.—G. K. Oliver, 7836 So. Morgan street, Chicago, Ill. Regular meeting, second Monday in each month, except June, July and August. Great Northern Hotel, Chicago, Ill.

CAR FOREMEN'S CLUB OF LOS ANGELES.—J. W. Krause, 514 East Eighth St., Los Angeles, Cal. Meetings second Friday of each month in the Pacific Electric Club building, Los Angeles, Cal.

CAR FOREMEN'S ASSOCIATION OF ST. LOUIS.—F. G. Weigman, 720 North Twenty-third street, East St. Louis, Ill. Regular meeting, first Tuesday in each month, except June, July and August, at American Hotel Annex, St. Louis, Mo.

CENTRAL RAILWAY CLUB.—T. J. O'Donnell, 1004 Prudential building, Buffalo, N. Y. Regular meeting, second Thursday each month, except June, July and August, at Hotel Statler, Buffalo.

CINCINNATI RAILWAY CLUB.—D. R. Boyd, 3328 Beckman St., Cincinnati. Regular meeting second Tuesday, February, May, September and November.

CLEVELAND RAILWAY CLUB.—F. L. Frericks, 14416 Adler Ave., Cleveland, Ohio. Meeting first Monday each month, except July, August and September at Hotel Hollenden, East Sixth and Superior Ave.

EASTERN CAR FOREMEN'S ASSOCIATION.—E. L. Brown, care of the Baltimore & Ohio, Staten Island, N. Y. Regular meetings fourth Friday of each month.

INTERNATIONAL RAILROAD MASTER BLACKSMITH'S ASSOCIATION.—W. J. Mayer, Michigan Central, 2347 Clark Ave., Detroit, Mich. Next meeting September 23-25, 1930, Hotel Morrison, Chicago.

INTERNATIONAL RAILROAD MASTER BLACKSMITH'S SUPPLY MEN'S ASSOCIATION.—J. H. Jones, Crucible Steel Company of America, 650 Washington boulevard, Chicago.

INTERNATIONAL RAILWAY FUEL ASSOCIATION.—C. T. Winkless, Room 707, LaSalle Street Station, Chicago. Next meeting May 6-9, 1930, Hotel Sherman, Chicago.

INTERNATIONAL RAILWAY GENERAL FOREMEN'S ASSOCIATION.—William Hall, 1061 W. Wabasha street, Winona, Minn. Next meeting, September 16 to 19, inclusive, Hotel Sherman, Chicago.

INTERNATIONAL RAILWAY SUPPLY MEN'S ASSOCIATION.—L. R. Pyle, Locomotive Firebox Company, Chicago. Meets with International Railway Fuel Association.

LOUISIANA CAR DEPARTMENT ASSOCIATION.—L. Brownlee, 3212 Delachaise street, New Orleans, La. Meetings third Thursday in each month.

MASTER BOILERMAKER'S ASSOCIATION.—A. F. Stiglmeier, secretary, 29 Parkwood St., Albany, N. Y. Annual meeting May 20-23, William Penn Hotel, Pittsburgh, Pa.

MASTER CAR BUILDERS' AND SUPERVISORS' ASSOCIATION.—A. S. Sternberg, master car builder, Belt Railway of Chicago. Next convention August 26-28, Book-Cadillac Hotel, Detroit.

NATIONAL SAFETY COUNCIL.—STEAM RAILROAD SECTION.—W. A. Booth, Canadian National, Montreal, Que. Annual congress, September 29-October 4, William Penn and Fort Pitt Hotels, Pittsburgh, Pa.

NEW ENGLAND RAILROAD CLUB.—W. E. Cade, Jr., 683 Atlantic Ave., Boston, Mass. Regular meeting second Tuesday in each month, excepting June, July, August and September. Copley-Plaza Hotel, Boston.

NEW YORK RAILROAD CLUB.—Meetings third Friday in each month, except June, July and August, at 29 West Thirty-ninth St., New York. Mrs. M. E. Hartman, acting secretary, 26 Cortlandt street, New York.

PACIFIC RAILWAY CLUB.—W. S. Wollner, P. O. Box 3275, San Francisco, Cal. Regular meetings, second Tuesday of each month in San Francisco and Oakland, Cal., alternately.

PUEBLO CAR MEN'S ASSOCIATION.—I. F. Wharton, chief clerk, Interchange Bureau, Pueblo, Colo.

RAILWAY BUSINESS ASSOCIATION.—Frank W. Naxon, 1124 Woodward building, Washington, D. C.

RAILWAY CAR MEN'S CLUB OF PEORIA AND PEKIN.—C. L. Roberts, chief clerk, Peoria & Pekin Union Railway, 217 Lydia avenue, Peoria, Ill.

RAILWAY CLUB OF GREENVILLE.—Paul A. Minnis, Bessemer & Lake Erie, Greenville, Pa. Meetings third Thursday of each month, except June, July and August.

RAILWAY CLUB OF PITTSBURGH.—J. D. Conway, 515 Grandview Ave., Pittsburgh, Pa. Regular meeting fourth Thursday in month, except June, July and August. Ft. Pitt Hotel, Pittsburgh, Pa.

RAILWAY EQUIPMENT MANUFACTURERS' ASSOCIATION.—F. W. Venton, Crane Company, 836 South Michigan avenue, Chicago. Meets with Traveling Engineers' Association.

RAILWAY FIRE PROTECTION ASSOCIATION.—R. R. Hackett, Baltimore & Ohio, Baltimore, Md. Next meeting October 21-23.

RAILWAY SUPPLY MANUFACTURERS' ASSOCIATION.—J. D. Conway, 1841 Oliver building, Pittsburgh, Pa. Meets with Mechanical Division and Purchases and Stores Division, American Railway Association.

ST. LOUIS RAILWAY CLUB.—B. W. Frauenthal, M. P. O. Drawer 24, St. Louis, Mo. Regular meetings, second Friday in each month, except June, July and August.

SOUTHERN AND SOUTHWESTERN RAILWAY CLUB.—A. T. Miller, P. O. Box 1205, Atlanta, Ga. Regular meetings third Thursday in January, March, May, June, September and November. Annual meeting third Thursday in November, Ansley Hotel, Atlanta, Ga.

SOUTHWEST MASTER CAR BUILDERS' AND SUPERVISORS' ASSOCIATION.—See Master Car Builders' & Supervisors' Association.

SUPPLY MEN'S ASSOCIATION.—E. H. Hancock, treasurer, Louisville Varnish Company, Louisville, Ky. Meets with Equipment Painting Section, Mechanical Division, American Railway Association.

SUPPLY MEN'S ASSOCIATION.—Bradley S. Johnson, W. H. Miner, Inc., Chicago. Meets with Master Car Builders and Supervisors' Association.

TRAVELING ENGINEERS' ASSOCIATION.—W. O. Thompson, 1177 East Ninety-eighth St., Cleveland, Ohio. Next meeting September 23-26, 1930, Hotel Sherman, Chicago.

WESTERN RAILWAY CLUB.—W. J. Dickinson, 343 South Dearborn street, Chicago. Regular meetings, third Monday in each month, except June, July and August.



THE CLEVELAND, CINCINNATI, CHICAGO & ST. LOUIS has let a contract for the construction of a water-softening plant at Harrisburg, Ill., to the Pittsburgh-Des Moines Steel Company, Pittsburgh, Pa.

THE SOUTHERN REPORTS that in the year 1929 five shop units, with a combined record of 6,732,253 man-hours worked, went through the year 1929 without a reportable injury to any employee.

THE PERE MARQUETTE plans the construction of new water-treating plants at Wyoming, Mich., and New Buffalo and a new water station at Benton Harbor. It is planned to construct new coaling stations at New Buffalo and at St. Thomas, Ont., and Sarnia. The coaling facilities at New Buffalo will be of 300-ton capacity.

THE NEW TURNTABLE which the Bangor & Aroostook is to install at Northern Maine Junction, Me., at a cost of \$30,918, is to be 100 ft. long and will replace an existing table 70 ft. long. The new turntable, which has been authorized at Oakfield, Me., at a cost of \$31,024, will also be 100 ft. long, replacing an existing 65-ft turntable.

Lackawanna Electrification

AS THEY CAN BE spared from service, the latest type of suburban coaches on the Delaware, Lackawanna & Western are being sent in lots of six to eight, to the shops, where the new vestibules and trap doors are being built in at the rate of one car per day, 24 of the 141 such cars already having been so equipped.

A sample motor car has been completed and the first completed motors and electrical equipment soon will be shipped for installation on this car.

Wage Statistics for November

THE NUMBER of employees reported by Class I railways to the Interstate Commerce Commission as of the middle of November, 1929, was 1,681,027, and the total compensation was \$240,797,028. Compared with returns for the corre-

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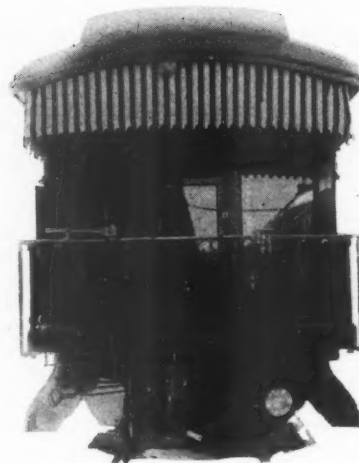
sponding month of 1928 the summary for November, 1929, shows an increase in the total number of employees of 568, or .03 per cent. The total compensation shows an increase of \$2,579,935, or 1.08 per cent.

Roller Bearings on Coal Cars

THE PENNSYLVANIA, in collaboration with the Timken Roller Bearing Company, has equipped 100 hopper cars of 70 tons capacity with roller bearings to determine the comparative resistance of cars so equipped as compared with standard cars. The cars, which have been put in service on a run between Cresson division points and the eastern seaboard, will soon be taken to Trinway, Ohio, where they will be tested under varying conditions of temperature, grade and speed.

The A. C. L.'s Centenary

THE ATLANTIC COAST LINE announces a centenary. It was on February 10, 1830, that citizens of Petersburg, Va., obtained from the General assembly of that state, a charter for the Petersburg Railroad, to extend from that city southward to some convenient point on the North Carolina line. This road, completed a few years after to Blakely, Va., 59 miles, was one



of the original links in what later became the Atlantic Coast Line. By the year 1900 about 100 railroads had been consolidated into the Atlantic Coast Line Railroad Company.

P. R. R. Safety Awards

THE PENNSYLVANIA has extended the scope of the competitive safety campaign, the President's Safety Trophy Contest, which is conducted each year. Heretofore, five trophies have been awarded yearly to the regions making the best safety records in five departments; namely, in maintenance of way, maintenance of equipment, station, train service and engine service. At the close of this year a total of 21 trophies will be presented covering competition among

* * *



Co-operative shop management committee of the Canadian National, meeting in Montreal, Que.

Under the Canadian National co-operative plan, committees representing the management and the various shop crafts work together in the budgeting of work and similar matters to produce greater continuity of operation, together with economy in production. The plan was introduced in the Canadian National shops a few years ago and has proved a great success. The photograph here reproduced shows Vice-President S. J. Hungerford of the C. N. R. addressing the shop craft representatives at a recent committee session in Montreal.

the regions as complete entities, the general divisions, the divisions and the departments of divisions. The regional departmental trophies will be discontinued. The awards will be based on the lowest number of casualties to employees on duty per million man-hours.

In order that a fair and equitable competitive basis may be established, the divisions will be arranged in three groups according to the number of man-hours worked, and separate awards will be made to the winning division in each group. In the division departmental competition, the group arrangement will be adhered to. A special trophy will be awarded the Altoona Works if they surpass the records of the regions in the maintenance of equipment department.

Impact Recorders

J. N. HAINES, superintendent of transportation of the Lehigh Valley, speaking before the January meeting of the Atlantic States Shippers' Advisory Board, in New York City, told of the experience of the Lehigh Valley and other roads with impact recorders. He said that the machine gives useful information not only about rough handling of freight, but also brings out cases of poor loading, poor storing and insufficient bracing. Defects disclosed by the use of the machine have enlisted the interest not only of the railroad company's freight handlers, but also many shippers. Shippers have in some instances asked to have recorders placed in cars which they send out, desiring to perfect their own packing and loading methods. Recorders are used in some instances in cars going over two or more roads, the two carriers co-operating.

In Chicago, recorders are now extensively used in cars used to move freight from one road to another and their use in this class of service is to be introduced at New York.

Answering the alleged suspicion of some shippers that this machine is used to stave off claims for damage, Mr. Haines said that, to the best of his knowledge, the recorder records had never been used in the discussion or settlement of any claim so far as the shipper or consignee is concerned.

The machines have been used with satisfaction on passenger trains.

Freight Records for 1929

FREIGHT TRAFFIC handled in 1929 by the railroads of the United States, measured in net ton-miles, was the greatest for any year on record, according to reports compiled by the Bureau of Railway Economics.

The total was 492,179,745,000 net ton-miles, which exceeded by 0.7 per cent the best previous record, established in 1926. The total for the year 1929 was 3.1 per cent above that for 1928.

In the Eastern district there was an increase of 5.2 per cent compared with 1928 but the Southern district showed a reduction of 0.5 per cent. The Western district reported an increase of 1.8 per cent.

In December, freight moved by the

Domestic Equipment Orders Reported During February, 1930

Locomotives			
Name of company	No. locos. ordered	Type	Builder
New York Central	10	2-8-4	Lima Loco. Wks.
Georgia, Ashburn, Sylvester & Camilla.....	5	4-6-4	American Loco. Wks.
	1	2-8-2	Baldwin Loco. Wks.
Total for the Month of February, 1930.....	16		
Freight Cars			
Name of company	No. cars ordered	Type	Builder
Erie	800	Hopper	Standard Steel
	100	Automobile	Pressed Steel
	100	Furniture	Pressed Steel
	450	Gondola	Greenville
	500	Box	American C. & F.
	200	Automobile	American C. & F.
Chesapeake & Ohio	1500	Steel Hopper	Standard Steel
	1500	Box	Standard Steel
	1500	Flat Bottom	American C. & F.
	500	Gondola	
		Box with end doors	Pressed Steel
Pere Marquette	1500	Box	Standard Steel
	1500	Auto Box	Pullman
	750	Flat Bottom	Ralston
		Gondola	
	500	Auto Box	Pressed Steel
	250	Furniture Box	Pressed Steel
	100	Flat	Bethlehem
	250	Flat Bottom	Greenville
		Gondola	
Hocking Valley	1500	Flat Bottom	American C. & F.
		Gondola	
Chicago, Rock Island & Pacific	50	Caboose	Company Shops
General Chemical Company	15	Tank	American C. & F.
Calumet & Hecla Consolidated Copper Company..	4	Dump	Koppel Industrial Car & Equipment
Wagner Quarries Co.	2	Dump	Koppel Industrial Car & Equipment
Pere Marquette	25	Caboose	Magor Car Corp.
Louisville & Nashville	500	Gondola	Pressed Steel Car Co.
	300	Hopper	
	250	Flat	
	500	Box	
	250	Gondola	Mount Vernon Car Mfg. Pullman C. & M. Corp.
Fleischmann Trans. Co.	1	Compartment Tank	General American Tank Car
Old Hickory Chemical Co.	1	Insulated Tank	General American Tank Car
Missouri Pacific	20	Drovers' Caboose	St. Louis Car Co.
National Tube Co.	3	Special Flat	Greenville Steel Car Co.
Eastern Michigan	10	Hart Convertible Ballast	American Car & Fdy. Co.
Norfolk & Western	500	Box	Company Shops
Total for the Month of February, 1930.....	15,931		
Passenger Cars			
Name of company	No. cars ordered	Type	Builder
Pullman Company	100	General Service Passenger Cars	Pullman Car & Mfg. Co.
Southern Pacific	10	Baggage	Pressed Steel Car Co.
Chicago, Rock Island & Pacific.....	4	Parlor Cars	Pullman Car & Mfg. Co.
	10	Coaches	
Chicago, Burlington & Quincy.....	10	Baggage	Company Shops
Total for the Month of February, 1930.....	134		

Class I railroads amounted to 36,039,869,000 net ton-miles, a reduction of 4.3 per cent below the same month in 1928. In the Eastern district, the volume of freight in December was a reduction of 2.6 per cent, while the Southern district reported a reduction of 7.9 per cent, and the Western 5.4 per cent.

The daily average movement per freight car in 1929 was 32.4 miles per day. This was an increase of 1.2 miles over the best previous daily average for any year, established in 1928, when the average was 31.2 miles and an increase of 2.1 miles above the daily average for 1927. The

average for 1929 was an increase of 10 miles above that for 1921.

The highest daily average for any one month on record was established in October, 1929, 36.3 miles.

The average speed per freight train in 1929 was also the highest ever attained, being 13.2 miles an hour, 0.3 mile above the best previous record, established in 1928.

The average load per car in 1929 was 26.9 tons, including l.c.l. freight as well as carload. This was an increase of 0.2 ton above that for 1928 but 0.3 ton below that for 1927.

Supply Trade Notes

THE DETROIT STEEL PRODUCTS COMPANY, Detroit, Mich., has purchased Holorib, Incorporated, Cleveland, Ohio.

CLYDE V. ROOT has been appointed representative of the Pyle National Company, Chicago, in charge of railroad and industrial floodlighting.

THE H. K. FERGUSON COMPANY, Cleveland, Ohio, has opened a branch office at 520 North Michigan avenue, Chicago, in charge of Henry Maag, a contract engineer.

E. L. WHITTEMORE, chairman of the board of the National Malleable & Steel Castings Company, Cleveland, Ohio, died on January 29 at his home in Cleveland.

THE DEVILBISS COMPANY has established a complete sales and service branch office at 2305 East Eighth street, Los Angeles, Cal., in charge of R. J. Burns.

RICHARD B. CARR, manager of the Pacific coast sales of the rail, plate, bar and shape department of the United States Steel Products Company, with headquarters at San Francisco, Cal., has retired.

THE KRING-BECKER ENGINEERING COMPANY, Cincinnati, Ohio, has been appointed representative in the Cincinnati and Louisville districts for the Pennsylvania Pump & Compressor Company, Easton, Pa.

THE NATIONAL ALUMINATE CORPORATION, Chicago, has opened a branch office at 1313 Sante Fe building, Dallas, Tex. C. M. Bardwell has been appointed southwestern railway representative in charge of this office.

D. H. FOSTER, assistant engineer of tests of the Missouri-Kansas-Texas, with headquarters at Parsons, Kan., has resigned to become lubricating sales engineer of the Mid-Continent Petroleum Company at Tulsa, Okla.

D. S. KERR has been placed in charge of the newly-established office of the Allis-Chalmers Manufacturing Company at Chattanooga, Tenn. This office is being operated as a branch of the Atlantic district office.

THE SIVYER STEEL CASTING COMPANY, Milwaukee, Wis., and the Nugent Steel Castings Company, Chicago, have been consolidated under the name of the Sivyver Steel Casting Company.

THE GEOMETRIC TOOL COMPANY, New Haven, Conn., has opened an office in the Stormfeltz - Loveley building, Detroit, Mich. The Charles A. Strelinger Company, who has represented the Geometric Company in Detroit in the past, will continue also to sell Geometric threading machines and chaser grinders.

OLIVER H. MELLUM and Andrew Speirs have been appointed assistant vice-presidents of the American Car & Foundry Company, Chicago. Both were formerly sales agents with headquarters at Chicago.

W. B. SIMPSON, president of the A. M. Castle & Co., Chicago, has been elected chairman of the board of directors. A. C. Castle, first vice-president, has been elected president to succeed Mr. Simpson, and Fred C. Flosi has been elected a director to take the place of Sidney Gardiner.

J. E. BUCKINGHAM has been appointed manager of the railroad department of the Worthington Pump & Machinery Corporation, with headquarters at Harrison, N. J., and W. B. Savary has been appointed assistant to the manager, with headquarters at the same point.

THE LINK-BELT LIMITED has opened a branch office in the Standard Bank Building, 510 West Hastings street, Vancouver, B. C., with Frank B. Wetherill in charge. Mr. Wetherill joined the Link-Belt organization 15 years ago, and for a number of years has been manager of the company's office and warehouse in Portland, Ore.

AT A RECENT MEETING of the board of directors of the Union Carbide Company and the Electro Metallurgical Company, both units of the Union Carbide & Carbon Corporation, New York, Benjamin O'Shea, formerly president, was elected chairman of the board of each company; Fred H. Haggerson, former vice-president of the two companies, was elected president to succeed Mr. O'Shea, and F. P. Gormely was elected vice-president and general manager of both companies.

JOSEPH T. RYERSON & SON, INC., Chicago, has completed increased facilities for storing and despatching its products at 1600 East Euclid avenue, Detroit, Mich. The new unit is 120 ft. by 300 ft. and includes six bays, one of which, a transfer bay, has facilities for the inside loading of freight cars. Five cranes move material from all parts of the building to the transfer bay where another crane loads it onto the cars. Truck loading facilities are provided by a driveway through the center of the building.

T. H. DRISCOLL of the Chicago office of the Gardner-Denver Company, Quincy, Ill., has been transferred to the Los Angeles branch. Fred V. Moore who has been a representative in the eastern states, has been transferred to Phoenix, Ariz., while R. J. Featherstone has been assigned to the New York office. Ian Duncan of Edinburgh, Scotland, after a preliminary training in the American plants of the company, will be assigned to the London office of Gardner-Denver Company, Ltd.

WALTER C. DOERING, vice-president of the Bradford Corporation, with headquarters at Chicago, has resigned to become vice-president of the American Steel



Walter C. Doering

Foundries, with headquarters at St. Louis, Mo. Mr. Doering was born in 1886, and in January, 1900, entered the employ of the St. Louis Car Wheel Company, which was merged into the Southern Wheel Company in 1913. In the latter year he was appointed assistant to vice-president and in 1917 was elected vice-president of the latter named company. He continued in that capacity until his resignation on January 1, 1923, to become vice-president of the Bradford Corporation.

W. E. CORRIGAN, who for a number of years has represented the American Locomotive Company and the Railway Steel-Spring Company as district sales manager at San Francisco, Cal., has been transferred to newly opened offices in the Tower building, Cleveland, Ohio. O. R. Hale, district sales manager of the two companies at Pittsburgh, Pa., has been transferred to San Francisco to succeed Mr. Corrigan. Arthur W. Sullivan will continue as sales agent with offices in the Farmers Bank building, Pittsburgh.

THE STANLEY ELECTRIC TOOL COMPANY, New Britain, Conn., has been organized as a subsidiary of the Stanley Works to manufacture and sell electrically-operated hand tools. The drills, screw drivers, bench grinders and aerial grinders are those developed and manufactured by the Stanley Rule & Level Plant. The saws were formerly manufactured by the Crowe Safety Saw Company, Inc., Cincinnati, Ohio, while the hammers were formerly manufactured by the Ajax Hammer Corporation, New York. An electrically-operated hand tool for the outside and inside cutting of sheet metal and sheet material was formerly manufactured by the Unishar Company, New York. The officers of the Stanley Electric Tool Company are as follows: L. M. Knouse, president; Cedric Powers, vice-president in charge of production; H. W. Blackman, secretary; L. W. Young, treasurer, and R. W. Chamberlain, sales manager.

W. C. MINIER and F. C. Lorenz have been added to the Cleveland sales and engineering staff of the Reading Chain & Block Corporation, Reading, Pa. Mr. Minier was formerly with the Shepherd Crane & Hoist Company, and Mr. Lorenz comes from the Cleveland Electric Tramrail Company.

LEWIS O. CAMERON, who represents the Edgewater Steel Company, the General American Car Company and the Baker Industrial Truck Company, has moved his office from the Munsey building to the Rust building, at the corner of Fifteenth and K streets, N. W., Washington, D. C.

NELSON L. REHNQUIST and Howard R. Gass have been elected vice-presidents of the St. Louis Car Company; George L. Kippenberger has been elected first vice-president and assistant general manager, and Edwin B. Meissner has been re-elected president and general manager. Mr. Rehnquist was with the Milwaukee Electric Railway & Light Company until 1911 when he went to St. Louis to take charge of the St. Louis Car Company. He will have jurisdiction of the purchases and stores and aircraft activities. Mr. Gass was formerly valuation engineer for the Missouri State Public Service Commission. Since 1920 he has been with the St. Louis Car Company in its sales department.

E. C. WALDVOGEL, vice-president in charge of sales of the Yale & Towne Manufacturing Company, Stamford, Conn., who has been in this company's service for the past 25 years, will retire from active participation in the company's affairs on April 1 in order to devote more of his time to personal affairs. He will however continue with the company in an advisory capacity and will hold the office of vice-president and remain a director. Walter B. Dodge, who has been assistant to the vice-president in charge of sales, has been appointed manager of all Stamford hard-



W. B. Dodge

ware sales. Mr. Dodge entered the service of the Yale & Towne Manufacturing Company as a young man twenty-four years ago and his duties have been diversified and numerous in sales work. James

C. Morgan, who takes complete charge of all materials handling equipment sales, entered the service of the Yale & Towne Manufacturing Company about ten years ago. T. T. Ludlum, formerly in charge of the Holyoke, Mass., branch of Yale & Towne, is in charge of production at the recently enlarged Philadelphia branch, and



J. C. Morgan

R. L. Higgins, assisted by Harold H. Gade and Neal E. McLoughlin, will handle all sales. The sales and service will cover eastern Pennsylvania, southern New Jersey, Delaware and Maryland.

A. A. HELWIG, southwestern representative of the Bradford Corporation, has been appointed acting vice-president, with headquarters at Chicago to take the place of W. C. Doering, vice-president, who has resigned. B. C. Wilkerson has been appointed southwestern representative with headquarters at St. Louis, succeeding Mr. Helwig.

M. W. SEYMOUR is now associated with the New York office of the Roller-Smith Company as a sales engineer. Mr. Seymour is a graduate of Brown University. For several months prior to his connection with the New York office of the Roller-Smith Company, he was located at the company's works, at Bethlehem, Pa. H. D. Stier, Atlanta, Ga., now represents the Roller-Smith Company in the states of Alabama, Florida, Georgia, North Carolina and South Carolina, and the H. N. Muller Company, Pittsburgh, Pa., now represents the company in western Pennsylvania, West Virginia and the Youngstown district in Ohio. Associated with Mr. Muller are H. E. Ransford and F. E. Harper.

A PLAN has been adopted by the boards of directors of Pullman Incorporated, the Standard Steel Car Company and the Osgood Bradley Car Company, under which the properties of the Standard Steel Car Company and its subsidiaries and of the Osgood Bradley Car Company will be acquired by a newly incorporated subsidiary of Pullman Incorporated, wholly owned by it, but to be operated as a group separately from the properties of its present manufactur-

ing subsidiary, the Pullman Car & Manufacturing Corporation. Upon the consummation of the plan, J. F. Drake, president of the Standard Steel Car Company, will become chairman of the board of Pullman Incorporated, the president of which is D. A. Crawford who is also president of the Pullman Company. P. H. Joyce, vice-president of the Standard Steel Car Company and a former president of the Illinois Car & Manufacturing Company, will become president of the new Standard-Bradley group. C. A. Liddle will remain as president of the Pullman Car & Manufacturing Corporation. The officers of the Standard-Bradley group in addition to Mr. Joyce as president, will be: R. L. Gordon, vice-president at New York, formerly vice-president of Standard; P. G. Jenks, vice-president at Chicago, formerly vice-president of Standard; W. V. McKee, vice-president at Worcester, formerly vice-president of Osgood-Bradley; C. F. Stembel, vice-president at Minneapolis, formerly vice-president of the Siemens-Stembel Company; J. C. Snyder, vice-president at Richmond, Va., formerly vice-president of the Richmond Car Works; C. W. Wright, vice-president at Pittsburgh, formerly vice-president of the Steel Car Forge Company, and William Bierman, secretary, formerly secretary of Standard.

THE GREENVILLE STEEL CAR COMPANY, which has been acquired by the Pittsburgh Forgings Company, retains its identity and now has on its board of directors the following members: Frank L. Fay, chairman, F. D. Foote, K. C. Gardner, W. S. Dietrich, George H. Rowley, Edwin Hodge, Jr., and J. T. Brennan. The officers of the Pittsburgh Forgings Company are Edwin Hodge, Jr., president; F. D. Foote, vice-president; R. A. Mitchel, vice-president in charge of operations, and C. E. Rafter, treasurer. Mr. Gardner becomes executive vice-president of the Greenville Steel Car Company, and W. S. Dietrich continues as vice-president in charge of operations, both with offices at Greenville. Mr. Fay, who continues as chairman of the board of the Greenville Steel Car Company, becomes a member of the board of the Pittsburgh Forgings Company, and Mr. Brennan continues also as assistant vice-president of the Greenville Steel Car Company.

The Pittsburgh Forgings Company, producers of drop forged and upset products, recently purchased the plant of the Riverside Forge & Machine Company, Jackson, Mich., which has since been operated as the Riverside division of the Pittsburgh Forgings Company, specializing in the forging and machining of automobile hubs. The Pittsburgh plant is located at Coraopolis, Pa., and produces automobile, railroad and miscellaneous forgings and upset products. The acquisition of the Greenville Steel Car Company still further diversifies the business of the Pittsburgh Forgings Company in the production of railroad forgings. The Greenville company manufactures new railroad equipment, including dump cars, and steel car parts, and handles car repairs.

JOHN S. LEMLEY, formerly vice-president of the Viloco Railway Equipment Company and the Okadee Company, Chicago, and of the Chas R. Long, Jr. Company, Louisville, Ky., has resigned from these companies and has purchased an interest in the T-Z Railway Equipment Company, Chicago, and has been elected vice-president of the latter company. Mr. Lemley entered railway service in July, 1893, as a fireman on the Wheeling division of the Baltimore & Ohio, in which capacity he served until November, 1908, when he resigned to become an engineer with the Chicago, Milwaukee, St. Paul &



J. S. Lemley

Pacific on the Puget Sound extension. In 1911 he resigned to enter the employ of the Baltimore & Ohio South Western as traveling engineer and in 1912 was promoted to supervisor of locomotive operation of this road and the Cincinnati, Hamilton & Dayton, with headquarters at Cincinnati. He resigned from this position in 1914 to accept a position with the Texas & Pacific in the mechanical department. In 1915 he left the Texas & Pacific to become associated with the G. F. Cotter Supply Company of Houston, Tex., remaining with that company until January 1, 1921, at which time he became associated with the Chas R. Long, Jr., Company, Louisville, Ky., the Okadee Company and the Viloco Railway Equipment Company, Chicago. After holding various positions with these companies, he was elected vice-president.

GEORGE G. CRAWFORD, for the past 22 years president of the Tennessee Coal Iron & Railroad Company and previous to that associated with the Carnegie Steel Company and the National Tube Company, has been elected president of the Jones & Laughlin Steel Corporation, a member of its board of directors and also a member of its executive committee, with headquarters at Pittsburgh, Pa., Herbert C. Ryding, vice-president in charge of operations since 1917 of the Tennessee Coal Iron & Railroad Company, has been elected president of that company, with headquarters at Birmingham, Ala., to succeed Mr. Crawford.

FRANCIS COLE PRATT, former vice-president and chairman of the manufacturing committee of the General Electric Com-

pany, died on January 20. Mr. Pratt was born in 1867 at Hartford, Conn., and was graduated from the Sheffield Scientific School of Yale University with the degree of Ph. B. in mechanical engineering in 1888. After graduation he was associated with the Pratt & Whitney Company, continuing with that company until he became vice-president. Mr. Pratt joined the General Electric Company in 1906 as assistant to E. W. Rice, in charge of manufacturing and engineering. He was appointed assistant to the president in 1913 and was elected vice-president in 1919. As vice-president he at first had charge of engineering and later of both engineering and manufacturing. He retired in 1927.

FOOTE BROS. GEAR & MACHINE COMPANY, Chicago, has appointed Max E. Landry, 202 Local building, Oklahoma City, Okla., its representative in the northern half of Oklahoma. The Amnux Equipment Company, 406 San Francisco street, El Paso, Tex., has been appointed district representative of the Texas territory lying west of a line drawn from Farwell to Sweetwater and then south to Spofford, and including all of New Mexico and all the states of Mexico, except the states of Nuevo Leon and Tamaulipas.

CLARENCE W. HODGES, general purchasing agent of the Worthington Pump & Machinery Corporation, died at a Pater-son, N. J., hospital on January 17, following an operation. Mr. Hodges was born at Randolph, Vt., on May 15, 1876, and was graduated from Williams College in 1900. For some years he was employed by the American Locomotive Company as purchasing agent, and since 1918 he had been employed in the same capacity by the Worthington Corporation.

THE P. H. & F. M. ROOTS COMPANY, Connersville, Ind., manufacturers of rotary positive blowers, pumps and meters, has merged with other interests and is now under the control of the Stacey Engineering Company, Columbus, Ohio. The new organization includes the P. H. & F. M. Roots Company, the Connersville Blower Company, Connersville, the Wilbraham-Green Blower Company, Pottstown, Pa., and the Stacey Brothers Gas Construction Company, Cincinnati, Ohio. The officers of the new company include Colonel Carmi A. Thompson, president; Corwin Abbott, vice-president and general manager; Fletcher S. Heath, vice-president, and Erle G. Meeks, secretary and treasurer. E. D. Johnston, who for the past forty-five years has been connected with the P. H. & F. M. Roots Company, has resigned as president of the company and has retired from active business. All companies involved in the merger will maintain their separate identities and organizations, and will continue to operate separately until the final plans of the merger can be definitely consummated.

THE GENERAL STEEL CASTINGS CORPORATION is constructing a plant at Eddystone, Pa., which, upon its completion during the next few months, will give the company four plants in the United States. The other three plants include

the Seaboard works at Chester, Pa., which was acquired from the American Locomotive Company, the Thurlow works at Chester, Pa., which was acquired from the American Steel Foundries, and the Commonwealth plant at Granite City, Ill., which was purchased from the Commonwealth Steel Company.

The Eddystone plant, the main bay of which is 996 ft. by 270 ft. and which has cranes with 90-ft. spans and 100-tons' capacity, will be able to produce locomotive frames 65 ft. in length and with cylinders cast integral.

THE AMERICAN ROLLING MILL COMPANY has moved its Philadelphia, Pa., office from 1213 Franklin Trust building to 2020 Lewis Tower. W. S. Stephenson is district sales manager and E. C. Bray is in charge of all sales to railroad companies.

THE SKF INDUSTRIES, INC., New York, has reorganized its railroad department and in the future all sales, engineering and service matters regarding railroad equipment will be handled direct from its home office. The company has a separate engineering division which devotes all of its time to railroad work. H. E. Brunner, chief engineer, will continue to direct the affairs of the railroad department, as he has done for the past 12 years. Earle M. Harshbarger, who has had charge of sales work in the East, now has charge of all sales for the railroad department, and B. W. Taylor, associated with the engineering department for a long time, will continue to



Earle M. Harshbarger

handle railroad engineering and service work. Mr. Harshbarger was born on April 14, 1887, at Ladoga, Ind., and received his education at Wabash College, Purdue University and Central Business College, Indianapolis, Ind. He served for 12 years with S. F. Bowser & Co., Fort Wayne, Ind., as manager of the railroad department for six years; district manager, New York office, for two years, and the remaining four years in engineering sales work. During the past three years Mr. Harshbarger served as eastern railroad representative of the SKF Industries, Inc. Mr. Taylor, was born on January 21, 1896, at Versailles, Ky., and was graduated from the University of Pennsylvania in the 1917 class

in mechanical engineering. He entered the employ of the Illinois Central in its maintenance of way department and later served in the United States Army and also as a lieutenant in the United States Navy. From 1920 to 1923 he was instructor in mechanical engineering at the University of Pennsylvania. He has been with the SKF Industries in its engineering department since 1923, supervising railroad engineering and service work.

ARCHIBALD CARR McLACHLAN, service engineer of the Superheater Company on the southeastern railroads, died at his home near Charlottesville, Va., on January 21. Mr. McLachlan was born in Ontario near Parkhill on August 3, 1870.



A. C. McLachlan

Until he was eighteen he worked on his father's farm and then for two winters did lumbering in the woods of Michigan. When he was twenty-one he entered the service of the Michigan Central as a fireman and five years later was promoted to the position of locomotive engineman. In 1901 he transferred to the Pere Marquette and in 1905 was appointed road foreman of engines. After 21 years of railroading he left the Pere Marquette and on November 1, 1912, became a service engineer for the Superheater Company. He resided in Atlanta, Ga., until September, 1928, when he moved to Virginia.

EDWARD C. FISHER, district sales manager of the American Locomotive Company with headquarters at St. Louis, Mo., died on February 17 at Rochester, Minn., following an illness of several months' duration.

HARRY AINSWORTH, president of Williams, White & Co., who died on February 6 at Moline, Ill., was born in Geneseo on May 9, 1862, and graduated from Oberlin College, at Oberlin, Ohio, in 1884, after which he graduated from Harvard Law School in 1887. After graduating he immediately became associated with his father in the management of Williams, White & Co., and after holding various positions with the company was appointed vice-president and general manager. Upon the death of his father in 1914 he became president and general manager.

Personal Mention

General

THE HEADQUARTERS of F. B. Barclay, superintendent of motive power of the Illinois Central, has been transferred from Memphis, Tenn., to Chicago.

J. B. BLACKBURN has been appointed mechanical engineer of the Chesapeake & Ohio, with headquarters at Richmond, Va., succeeding S. B. Andrews.

A. W. BYRON, master mechanic of the Philadelphia Terminal division of the Pennsylvania, has been appointed superintendent of motive power, Central Pennsylvania division, succeeding B. M. Swope, transferred.

H. W. JONES, superintendent of motive power of the Western Pennsylvania division of the Pennsylvania, has been appointed general superintendent of motive power, Central Region, succeeding R. H. Flinn.

R. H. FLINN, general superintendent of motive power of the Central Region of the Pennsylvania, has been appointed general superintendent, Western Pennsylvania division, with headquarters at Pittsburgh, Pa., succeeding J. H. Redding, deceased.

B. M. SWOPE, superintendent of motive power of the Central Pennsylvania division of the Pennsylvania, has been appointed superintendent of motive power, Western Pennsylvania division, succeeding H. W. Jones.

J. J. WENZEL, master mechanic of the New York Central at Elkhart, Ind., has been appointed acting district superintendent of motive power, with jurisdiction over the Fourth district, succeeding F. F. McCarthy.

S. B. ANDREWS, mechanical engineer of the Chesapeake & Ohio, with headquarters at Richmond, Va., has been appointed engineer of motive power of the advisory mechanical committee of that company, the Erie, the Hocking Valley, the New York, Chicago & St. Louis, and the Pere Marquette, with headquarters at Cleveland, Ohio.

F. F. MCCARTHY, district superintendent of motive power of the lines of the New York Central west of Buffalo, N. Y., with headquarters at Elkhart, Ind., has been appointed special assistant superintendent of motive power of those lines, with headquarters at Cleveland, Ohio.

THE POSITIONS of fuel supervisor and general air brake inspector on the Oregon-Washington Railroad & Navigation Company have been consolidated and John Daniels, fuel supervisor, with headquarters at Portland, Ore., has been appointed to this position.

J. C. STUMP, master mechanic of the Chicago & North Western at Escanaba, Mich., has been promoted to the position of assistant superintendent of motive power and machinery, with headquarters at Chicago.

W. T. WESTALL, district master car builder of the New York Central Lines west of Buffalo, N. Y., with headquarters at Collinwood, Ohio, has been promoted to special assistant superintendent of rolling stock, with headquarters at Cleveland, Ohio.

Car Department

L. H. GELKER, formerly car foreman of the Wabash, at Decatur, Ill., has been promoted to the position of general car foreman, with headquarters at Moberly, Mo.

H. F. DOWNEY, material inspector of the Chesapeake & Ohio at Richmond, Va., has been promoted to the position of car foreman, with headquarters at Hinton, W. Va.

EMIL ERICKSON, general foreman of the car department of the New York Central at Adrian, Mich., has been appointed acting district master car builder of the Third district at Collinwood, Ohio, succeeding W. T. Westall.

C. V. RATCLIFF, general car foreman of the Huntington shops of the Chesapeake & Ohio, has been promoted to the position of shop superintendent, with headquarters at Russell, Ky. Mr. Ratcliff was born on May 3, 1882, in Lawrence County, Ohio. From 1888 to 1898 he attended the rural schools of Lawrence County and the public schools of Huntington, W. Va. He took an International Correspondence School course and in 1911 graduated with a B. S. degree from the Virginia Mechanics Institute, Richmond, Va. He entered the employ of the Chesapeake & Ohio on January 3, 1899, as a laborer at Huntington, W. Va., the previous year having been employed as a painter boy in the erecting shop of the Ensign Manufacturing Company, now the American Car & Foundry Company, at Huntington. From March 1, 1900, to September 1, 1900, he served as a car repairer for the C. & O. at Huntington, and from the latter date until November 1 of the same year was employed as a car repairer in the plant of the Illinois Car & Equipment Company at Urbana, Ohio. From November 5, 1900, to February 1, 1901, he was a car repairer at the shops of the Columbus, Sandusky & Hocking (now a part of the Pennsylvania) at Columbus, Ohio; from February 1 to July 31, 1901, a car repairer at the Huntington shops of the C. & O.; from August 1 to December 1, 1901, a car builder in the employ of the American Car & Foundry Company at

Huntington; from December 4, 1901, to April 1, 1902, a car builder for the Pressed Steel Car Company at McKees Rocks, Pa.; from April 1, 1902 to October 1, 1904, a car builder for the Pittsburgh Coal Company at Coraopolis, Pa., and from October 4, 1904, to October 1, 1905, a car builder for the American Car & Foundry Company at Huntington. Mr. Ratcliff began his continuous service with the C. & O. on October 5, 1905, as a car repairer at the Huntington shops. On April 1, 1907, he was promoted to



C. V. Ratcliff

the position of shop draftsman at Huntington; on March 1, 1909, was appointed mechanical draftsman, mechanical engineer's office, at Richmond, Va.; on November 1, 1911, became general car inspector, with headquarters at Covington, Ky., and from September 16, 1919, to September 16, 1929, was general car foreman at Huntington.

Master Mechanics and Road Foremen

VICTOR U. POWELL, assistant master mechanic of the Illinois Central at Chicago, has retired from active duty after 43 years of railway service.

W. M. EVANS, master mechanic of the Russell division of the Chesapeake & Ohio at Russell, Ky., has been appointed assistant master mechanic of the Cincinnati division, with headquarters at Covington, Ky.

HUGH RONALDS, assistant master mechanic of the Lehigh & New England at Pen Argyle, Pa., has been appointed master mechanic, with headquarters in the same city, replacing R. L. Wyman, deceased. The office of assistant master mechanic has been abolished.

THE JURISDICTION OF J. P. Roquemore, master mechanic of the Louisiana division of the Missouri Pacific, with headquarters at Monroe, La., has been extended to include the Little Rock division which was formerly under the jurisdiction of J. B. Crahan.

W. WALKER, formerly locomotive foreman of the Western region of the Canadian National at Saskatoon, Sask.,

and recently acting master mechanic of the Prince Albert division at Prince Albert, Sask., has been promoted to the position of master mechanic of that division, succeeding W. L. Loomis, deceased.

T. E. CARTER, master mechanic of the Gulf Coast Lines at Kingsville, Tex., has been transferred to the International-Great Northern, with headquarters at Houston, Tex.

R. SMITH, master mechanic of the Union of Memphis, with headquarters at Memphis, Tenn., has had his jurisdiction extended to include the Memphis division of the Missouri Pacific. The Memphis division was previously under the jurisdiction of J. B. Crahan.

O. B. CAVANAUGH has been appointed master mechanic of the Northwestern Pacific, with headquarters at Tiburon, Cal. Mr. Cavanaugh has jurisdiction over the motive power and car departments, including the maintenance of electric car equipment.

THE JURISDICTION OF C. B. Hitch, master mechanic of the Cincinnati division of the Chesapeake & Ohio, has been extended to include the Russell division, and his headquarters have been removed from Covington, Ky., to Russell.

O. PROTZ, master mechanic of the Chicago & North Western at Winona, Minn., has been transferred to Escanaba, succeeding J. C. Stump.

S. J. STARK, master mechanic of the International-Great Northern at Houston, Tex., has been transferred to the Gulf Coast lines with headquarters at Kingsville, Tex., succeeding T. E. Carter.

FRED A. SCHILLING, who has been appointed assistant master mechanic of the Southern Pacific, with headquarters at Bayshore, Cal., was born on December 25, 1888, at Dubuque, Iowa. He attended high school for two years and in February, 1904, entered the service of the Illinois Central as a machinist apprentice. From January, 1908, until October, 1915, he was successively in the employ of the Denver & Rio Grande, the Missouri Pacific, the Chicago, Milwaukee & St. Paul, the Northern Pacific, the Great Northern, and the Western Pacific as a machinist. In the latter year he was appointed enginehouse foreman of the Southern Pacific, from which position he advanced to assistant master mechanic. During 1918 and 1919 Mr. Schilling was with the U. S. Army, 49th Engineers, in France.

Shops and Enginehouse

FRANK B. HARMAN, assistant superintendent, in charge of the locomotive department, of the San Bernardino (Cal.) shops of the Atchison, Topeka & Santa Fe, has been promoted to superintendent of the Albuquerque (N. M.) shops, succeeding D. E. Barton, who has been assigned to other duties.

W. L. SMITH has been promoted to the position of day enginehouse foreman of the Southern, with headquarters at Sheffield, Ala., succeeding F. L. Brower.

R. SALKELD has been appointed superintendent of shops of the Northwestern Pacific, with headquarters at Tiburon, Cal.

HENRY C. MOORE, erecting shop foreman at the San Bernardino, Cal., shops of the Atchison, Topeka & Santa Fe, has been promoted to the position of assistant superintendent of shops at that point, succeeding F. B. Harman.

F. H. McANALLY, night enginehouse foreman of the Southern at Memphis, Tenn., has been transferred to Sheffield, Ala., as night enginehouse foreman at that point.

R. H. HARRINGTON, a machinist in the employ of the Southern at Sheffield, Ala., has been promoted to the position of night enginehouse foreman, with headquarters at Memphis, Tenn., succeeding F. H. McAnally.

Obituary

C. E. BROOK, master mechanic on the Western lines of the Chicago, Milwaukee, St. Paul & Pacific at Bellingham, Wash., died on January 12.

THOMAS N. GILMORE, who served as assistant to the general superintendent of motive power of the Chicago, Rock Island & Pacific at Chicago during 1904 and 1905, died at his home at El Paso, Tex., on January 15. Mr. Gilmore had also served for a time as master mechanic of the Terminal Railroad Association of St. Louis.

PIERRE O. WOOD, assistant superintendent of motive power of the St. Louis-San Francisco, with headquarters at Springfield, Mo., died in that city on February 20 at the age of 53 years. Mr. Wood, who was a native of Memphis, Tenn., had been connected with the Frisco for 36 years. He entered railway service on that road as a machinist apprentice at Memphis in 1893, advancing to machinist eight years later. For five months during 1903, he served as a fireman on the Illinois Central, then returning to the Frisco as an air brake machinist. From 1904 to 1913 Mr. Wood served successively as a fireman on the Southern division, as an engineman and as a traveling engineer. In 1913 he was promoted to assistant superintendent of locomotive performance at Springfield, then being further promoted to superintendent of locomotive performance, with headquarters at the same point, in 1914. Two years later he was advanced to assistant general superintendent of motive power at Springfield, where he remained until federal control of the railroads, when he was appointed superintendent of the Southern division, with headquarters at Memphis. Mr. Wood had been assistant superintendent of motive power continuously since March 1, 1920.